Evaluation of seizure foci and genes in the Lgi1(L385R/+) mutant rat(Dissertation_全文)

AUTHOR(S):

Fumoto, Naohiro

Evaluation of seizure foci and genes in the *Lgi1*$^{L385R/+}$ mutant rat

Naohiro Fumoto[a, b], Tomoji Mashimo[b]*, Atsushi Masui[c], Saeko Ishida[b], Yuto Mizuguchi[c], Shoko Minamimoto[c], Akio Ikeda[a, d], Ryosuke Takahashi[a], Tadao Serikawa[b], Yukihiro Ohno[c]

[a]*Department of Neurology, Graduate School of Medicine, Kyoto University, Kyoto 606-8501, Japan*

[b]*Institute of Laboratory Animals, Graduate School of Medicine, Kyoto University, Kyoto 606-8501, Japan*

[c]*Laboratory of Pharmacology, Osaka University of Pharmaceutical Sciences, Takatsuki 569-1094, Japan*

[d]*Department of Epilepsy, Movement Disorders and Physiology, Graduate School of Medicine, Kyoto University, Kyoto 606-8501, Japan.*

*Corresponding author: T. Mashimo, Institute of Laboratory Animals, Graduate School of Medicine, Kyoto University, Yoshidakonoe-cho, Sakyo-ku, Kyoto 606-8501, Japan. Tel.: +81-75-753-9318; fax: +81-75-753-4409.

E-mail address: tmashimo@anim.med.kyoto-u.ac.jp (T. Mashimo)

ABSTRACT

Mutations in the leucine-rich, glioma inactivated 1 (LGI1) gene have been identified in patients with autosomal dominant lateral temporal lobe epilepsy (ADLTE). We previously reported that Lgi1 mutant rats, carrying a missense mutation (L385R) generated by gene-driven N-ethyl-N-nitrosourea (ENU) mutagenesis, showed generalized tonic-clonic seizures (GTCS) in response to acoustic stimuli. In the present study, we assessed clinically-relevant features of Lgi1 heterozygous mutant rats (Lgi1L385R/+) as an animal model of ADLTE. First, to explore the focus of the audiogenic seizures, we performed electroencephalography (EEG) and brain Fos immunohistochemistry in Lgi1L385R/+ and wild type rats. EEG showed unique seizure patterns (e.g., bilateral rhythmic spikes) in Lgi1L385R/+ rats with GTCS. An elevated level of Fos expression indicated greater neural excitability to acoustic stimuli in Lgi1L385R/+ rats, especially in the temporal lobe, thalamus and subthalamic nucleus. Finally, microarray analysis revealed a number of differentially expressed genes that may be involved in epilepsy. These results suggest that Lgi1L385R/+ rats are useful as an animal model of human ADLTE.

Keywords

ADLTE; LGI1; Rats; EEG; Fos; Microarray

Highlights

>EEG of *Lgi1*$^{L385R/+}$ rats shows patterns that correspond to seizure behavior.

>Neural activity is increased in the lateral temporal lobe, including auditory cortex.

>Microarray analysis identified candidate genes responsible for audiogenic seizures.

Abbreviations

ADLTE, autosomal dominant lateral temporal lobe epilepsy; AGS, audiogenic seizures; EEG, electroencephalography; ENU, N-ethyl-N-nitrosourea; GTCS, generalized tonic-clonic seizures; IR, immunoreactivity; Lgi1, leucine-rich, glioma inactivated 1;

1. Introduction

Autosomal dominant lateral temporal lobe epilepsy (ADLTE) is a rare familial partial epilepsy syndrome mainly reported in Europe, the United States, Australia and Japan (Kawamata et al., 2009). The estimated penetrance ranges widely from 51 to 80% (Ottman et al., 1995; Ottman et al., 2004; Michelucci et al., 2009). ADLTE is characterized by focal seizures with auditory auras such as simple sound or auditory hallucinations in 55–64% of cases (Michelucci et al., 2003; Ottoman et al., 2004). Secondarily generalized tonic-clonic seizures (GTCS) are seen in 90% of cases (Michelucci et al., 2009). In some patients, seizures are induced by acoustic stimuli such as sudden noises or answering the phone (Winawer et al., 2000; Michelucci et al., 2003; Michelucci et al., 2007), indicating a lateral temporal lobe onset. Some MRI studies have reported developmental abnormalities in the left lateral temporal lobe of patients (Kobayashi et al., 2003; Tessa et al., 2007). Fujita et al. (2009) also found left lateral temporal lobe hypometabolism using FDG-PET, and Brodtkorb et al. (2005) reported a predominance of left temporal EEG abnormalities. In addition, a mutation in the leucine-rich, glioma inactivated 1 (*LGI1*) gene has recently been reported to be a cause of ADLTE (Kalachikov et al., 2002; Morante-Redolat et al., 2002), and Kawamata et al. (2009) reported two ADLTE families with *LGI1* mutations in Japan.

Lgi1 null knockout mice show spontaneous seizures and die within 20 days of birth, while heterozygous *Lgi1* mice do not have spontaneous seizures, but show auditory stimulus-induced seizures (Fukata et al., 2010). A lack of *Lgi1*

also reduces synaptic transmission mediated by AMPA, ADAM22, and ADAM23 receptors in the hippocampus (Fukata et al., 2010) and enhances excitatory synaptic transmission by increasing the release of glutamate (Yu et al., 2010). Seizure-induced damage, such as neuronal loss, mossy fiber sprouting, astrocyte reactivity and granule cell dispersion in the hippocampus after recurrent seizures, was also reported in *Lgi1*$^{-/-}$ mice (Chabrol et al., 2010). Rat models, because of their larger brains, are useful for studying clinically relevant features such as the detection of seizure foci. We therefore generated an *Lgi1* missense mutant (L385R) rat on an F344 background by N-ethyl-N-nitrosourea mutagenesis (Baulac et al., 2012). *Lgi1* homozygous (*Lgi1*$^{L385R/L385R}$) mutant rats have spontaneous seizures after postnatal day (P) 10 and die prematurely (by P17). Although *Lgi1* heterozygous (*Lgi1*$^{L385R/+}$) mutant rats do not have spontaneous seizures, all *Lgi1*$^{L385R/+}$ rats primed with acoustic stimuli at P16 displayed wild running behavior and subsequent GTCS after exposure to acoustic test stimuli at 8 weeks (Baulac et al., 2012).

Here, we describe further study of the *Lgi1*$^{L385R/+}$ mutant rat, using electroencephalography (EEG) and Fos-immunoreactivity (Fos-IR) to identify the foci of audiogenic seizures (AGS), and microarray analysis to identify candidate genes that may be responsible for AGS.

2. Materials and methods

2.1. Experimental animals

Lgi1 mutant rats carrying a heterozygous missense mutation (L385R/+) (strain name, F344-*Lgi1*^{m1kyo}) (Baulac et al., 2012), and wild type (WT) F344/NSlc rats were bred and maintained at the Institute of Laboratory Animals, Graduate School of Medicine, Kyoto University, in air-conditioned rooms under a 14-h light/10-h dark cycle. Animal care and experiments conformed to the Guidelines for Animal Experiments and were approved by the Animal Research Committee of Kyoto University.

2.2. Audiogenic seizure induction

Lgi1$^{L385R/+}$ rats and WTs were divided into 3 groups (Fig. 1A). Group A (8 *Lgi1*$^{L385R/+}$ rats and 6 WTs) received no acoustic stimuli; Group B (7 *Lgi1*$^{L385R/+}$ rats and 9 WTs) received an acoustic priming stimulus only (120 dB, 10 kHz, 1 min.) at P16; Group C (7 *Lgi1*$^{L385R/+}$ rats and 7 WTs) received both the priming stimulus and an acoustic test stimulus (120 dB, 10 kHz, 5 min.) at 8 weeks of age (Fig. 1A), as previously described (Baulac et al., 2012).

2.3. EEG during seizures

Cortical EEG was recorded from group C rats, with simultaneous behavioral observation. At 6 weeks of age, electrodes were positioned stereotaxically (Paxinos and Watson, 2007; Hanaya et al., 2012) under sodium pentobarbital anesthesia (40 mg/kg i.p., Somnopentyl®, Kyoritsu Seiyaku Corp., Tokyo, Japan). A stainless steel bipolar electrode (0.2 mm diameter) was implanted in all rats in the left lateral temporal lobe (–3.96 mm posterior from bregma (P); 6.0 mm lateral from midline (L); –5.0 mm

depth from brain surface (D)). Then, in six rats (three per genotype), a screw electrode (1 mm diameter) was placed in the left frontal lobe (P, -3.8; L, 2.0; D, -2.2). In three other *Lgi1*$^{L385R/+}$ rats and two WTs, a second 0.2 mm bipolar electrode was implanted in the right lateral temporal lobe (P, –3.96; L, –6.0; D, –5.0). A reference electrode was fixed on the frontal cranium. Electrode positions are shown in Fig. 1C. The rats recovered for 2 weeks and EEG was recorded at 8 weeks (Baulac et al., 2012).

2.4.Fos immunohistochemistry

At 8 weeks of age (groups A and B), or 2-h after the last acoustic stimulus (group C), rats were perfused with 4% paraformaldehyde and Fos immunohistochemistry was performed as described by Ohno et al. (2009). Fos-IR nuclei were counted within a 350-μm × 350-μm grid laid over each of the brain regions illustrated in Fig. 2A by observers who were blinded to seizure activity.

2.5. Microarrays

Lateral temporal lobes were dissected from rats in groups B and C (n=3 per group). Brain tissues were transported on ice immediately after surgery and pulverized in 1 ml of Isogen reagent (Nippon Gene, Tokyo, Japan) using a tissue homogenizer. Fifty milligrams of tissue from the temporal lobes were used for RNA isolation. Total RNA was then extracted and purified using an RNase free kit containing chloroform, isopropanol, and ethanol according to the protocol of Isogen reagent. The quantity and quality of the RNA was determined with a NanoDrop ND-1000 UV-vis spectrophotometer (Thermo

Scientific, Wilmington, DE, USA). One-color hybridization was performed using the SurePrint G3 Rat GE 8 × 60 K microarray (Agilent Technologies, Santa Clara, CA, USA) and data were generated using Agilent Feature Extraction software. Scatter plot clustering, and pathway analysis were conducted using GeneSpringGX software (Agilent Technologies).

2.6. Statistical analysis

All values are expressed as mean ± SEM. Statistical significance at $p < 0.05$ was determined by Student's *t*-test.

3. Results and discussion

3.1 Audiogenic seizures and EEG characteristics

The auditory test stimulus induced wild running behavior, typical of AGS, in all WT and *Lgi1*$^{L385R/+}$ rats in group C (n=7 per group). In addition, all *Lgi1*$^{L385R/+}$ rats had GTCS immediately after wild running (Fig. 1B and Supplementary video). Acoustic priming stimuli at P16 were critical for inducing AGS in *Lgi1*$^{L385R/+}$ rats, as we reported previously (Baulac et al., 2012). EEG in *Lgi1*$^{L385R/+}$ rats showed 5–7 Hz slow rhythmic activity and then rhythmic spikes (Fig. 1D).

An onset of AGS at 8 weeks in rats is comparable to the age of onset of ADLTE in humans (Michelucci et al., 2009). The developing auditory system of rats at P16 is plastic enough to be affected by environmental acoustic stimuli (Romijn et al., 1991; Mashimo et al., 2010). This suggests that

newborn babies with a mutation in *LGI1* may benefit from an environment with minimal acoustic stimuli until the sensitive neurodevelopmental phase has passed. Indeed, considering the incomplete penetrance of ADLTE in families (Ottman et al., 1995; Ottman et al., 2004; Michelucci et al., 2009), environmental factors such as acoustic stimuli before neurological maturation may be essential for evoking seizures in later life.

No interictal EEG abnormality was observed in WT or *Lgi1*$^{L385R/+}$ rats without acoustic stimulation. Furthermore, no notable time-lags in the onset of wild running behavior or GTCS were observed between the two hemispheres (Fig. 1E), or between the left lateral temporal lobe and left frontal lobe (Fig. 1F). In patients with ADLTE, however, the left lateral temporal lobe is preferentially affected. The nature of these differences is unclear; however, the existence of intrinsic interhemispheric differences remains debated (Cain et al., 1989; Vinogradova, 2010). In addition, the brain may have functional asymmetry, observable in the lateralization of reinforcement sensitivity in rats (Glick and Ross, 1981), indicating that both congenital and environmental factors might contribute to the hemispheric asymmetry in epileptogenesis.

3.2 Fos immunohistochemistry after AGS

After AGS (group C), *Lgi1*$^{L385R/+}$ rats had a marked elevation of Fos-IR cells compared with those that received a priming stimulus only (group B), in several structures including the temporal lobe, thalamus and hypothalamus (Fig. 2C). Elevated Fos immunoreactivity in group C WT rats was observed

only in the posterior hypothalamus and CA2 field of the hippocampus (Fig. 2D).

Fos immunoreactivity was not different between *Lgi1*$^{L385R/+}$ and WT rats without acoustic stimulation (group A) in any brain region except the posteromedial cortical amygdaloid nucleus (Fig. 2B). Similarly, *Lgi1*$^{L385R/+}$ rats in groups A and B showed no differences in Fos-IR cell numbers except a reduction of Fos activation in the cingulate cortex and dorsomedial striatum after the priming stimulus (Fig. 2E). In WT rats, however, markedly more Fos-IR cells were observed in group B in numerous subregions in the cortex, hippocampus, amygdala, thalamus, and hypothalamus, compared with group A (Fig. 2F).

The excited areas in *Lgi1*$^{L385R/+}$ rats after GTCS, such as the temporal lobe and thalamus, correspond to the acoustic neural network (Valjakka et al., 2000). These areas are also consistent with the epileptic focus in human ADLTE patients, whereas previous studies indicate that seizures initiate in the hippocampus in *Lgi1* knockout mice (Fukata et al., 2010; Baulac et al., 2012). LGI1 protein is abundant in the human temporal neocortex, especially in the lateral temporal lobe (Furlan et al., 2006), while mouse *Lgi1* is highly expressed in the dentate gyrus and CA3 field of the hippocampus (Senechal et al., 2005; Herranz-Perez et al., 2010). While spontaneous seizures originate in the hippocampus in mice and rats, AGS in rats may originate in the acoustic neural network, as is seen in human ADLTE patients.

3.3 Gene expression in lateral temporal lobe after AGS

After exclusion of unnamed genes, and genes with less than a twofold difference in expression, a total of 447 genes with differential expression between groups B and C were identified in *Lgi1*$^{L385R/+}$ rats (Fig. 3A) and in WTs (Fig. 3B). In *Lgi1*$^{L385R/+}$ rats, 99 genes were upregulated and 109 were downregulated in group C compared with group B, while in WTs 85 genes were upregulated and 200 were downregulated. A summary of differentially expressed genes is provided in Fig. 3C, and fold-change values for all 447 genes are provided in Supplementary Table S1.

Some of the differentially expressed genes have previously been associated with epilepsy (Supplementary Table S2 and Fig. 3C). *Adora2a* and *Rgs9* interact with *Lgi1*, according to the STRING database; these interactions might affect epileptogenesis in *Lgi1*$^{L385R/+}$ rats. *Egr2* and *c-Fos* are both activity-dependent genes whose expression is highly correlated with the amplitude and frequency of interictal spikes (Rakhade et al., 2007). However, this is inconsistent with the downregulation of *Egr2* in *Lgi1*$^{L385R/+}$ rats following the acoustic test stimulus. Considering the apparent inhibition of Fos activation in *Lgi1*$^{L385R/+}$ rats after the acoustic priming stimulus, suppression of *c-Fos* and *Egr2* might be related to epileptogenesis in *Lgi1*$^{L385R/+}$ rats. *Kcnj13* was previously reported as a candidate gene for epileptogenicity (Winden et al., 2011); however, its expression was downregulated after the test stimulus in *Lgi1*$^{L385R/+}$ rats. Conversely, it was reported that mice lacking the *Stam* gene had a loss of hippocampal CA3 pyramidal neurons (Yamada et al., 2001), whereas the expression of *Stam* was upregulated in *Lgi1* mutant rats after the test stimulus. These results

indicate that the change in expression of these genes was due to the response after GTCS rather than to the epileptic susceptibility of *Lgi1* mutant rats. In addition, genes associated with inflammation, such as interleukin 1 beta (*Il1b*) and chemokine (C-C motif) ligand 3 (*Ccl3*), were particularly upregulated after the audiogenic seizures.

The *Lgi1* gene itself and 16 genes previously reported to be associated with it showed no significant differences in mRNA expression (Table 1). This is consistent with the idea that the phenotype of *Lgi1*$^{L385R/+}$ rats is derived from the loss of functional LGI1 protein rather than that of mRNA (Baulac et al., 2012). Most patients with ADLTE have mutations in the *LGI1* gene that impair protein secretion (Senechal et al., 2005; Michelucci et al., 2009; Nobile et al., 2009; Di Bonaventura et al., 2011). Recently, Striano et al. (2011) reported a family with ADLTE with a novel *LGI1* mutation (R407C) that did not disturb LGI extracellular protein secretion; the R407C *LGI1* mutation, however, disrupts interactions with its target proteins (Striano et al., 2011). In the case of *Lgi1*$^{L385R/+}$ rats, we previously demonstrated that L385R-LGI1 protein was unstable and appeared to have a short half-life, leading to loss of function (Baulac et al., 2012).

4. Conclusions

Neurons in the lateral temporal lobe, in particular the auditory cortex, of *Lgi1*$^{L385R/+}$ rats were significantly activated by acoustic stimuli. The expression levels of a subset of genes which may be involved in epilepsy were

significantly changed uniquely in *Lgi1*$^{L385R/+}$ rats after AGS, while those of *Lgi1* itself and associated genes were not altered. Our study indicates the existence of an unknown seizure mechanism in the AGS rats and highlights the utility of *Lgi1*$^{L385R/+}$ rats as an animal model of ADLTE.

Author Contributions

NF conceived the study and wrote the manuscript. TM designed and coordinated the study. SI assisted with EEG recording and microarray. JM, YM, and SM performed Fos immunohistochemistry. AI, RT, TS, and YO participated in interpreting the results and revising the manuscript. All authors read and approved the final manuscript.

References

Baulac, S., Ishida, S., Mashimo, T., Boillot, M., Fumoto, N., Kuwamura, M., Ohno, Y., Takizawa, A., Aoto, T., Ueda, M., Ikeda, A., LeGuern, E., Takahashi, R., Serikawa, T., 2012. A rat model for LGI1-related epilepsies. Hum. Mol. Genet. 21(16), 3546-3557.

Brodtkorb, E., Steinlein, O. K., Sand, T., 2005. Asymmetry of long-latency auditory evoked potentials in *LGI1*-related autosomal dominant lateral temporal lobe epilepsy. Epilepsia 46(10), 1692-1694.

Cain, D. P., Desborough, K. A., McKitrick, D. J., Ossenkopp, K.-P., 1989. Absence of a hemispheric difference in seizure sensitivity and kindling rate in the rat brain. Physiol. Behav. 45(2), 219-220.

Chabrol, E., Navarro, V., Provenzano, G., Cohen, I., Dinocourt, C., Rivaud-Péchoux, S., Fricker, D., Baulac, M., Miles, R., Leguern, E., Baulac, S., 2010. Electroclinical characterization of epileptic seizures in leucine-rich, glioma-inactivated 1-deficient mice. Brain 133(9), 2749-2762.

Di Bonaventura, C., Operto, F. F., Busolin, G., Egeo, G., D'Aniello, A., Vitello, L., Smaniotto, G., Furlan, S., Diani, E., Michelucci, R., Giallonardo, A. T., Coppola, G., Nobile, C., 2011. Low penetrance and effect on protein secretion of LGI1 mutations causing autosomal dominant lateral temporal epilepsy. Epilepsia 52(7), 1258-1264.

Fujita, Y., Ikeda, A., Kadono, K., Kawamata, J., Tomimoto, H., Fukuyama, H., Takahashi, R., 2009. Clinical features in a Japanese patient with autosomal dominant lateral temporal epilepsy having LGI1 mutation. Rinsho Shinkeigaku 49(4), 186-190.

Fukata, Y., Lovero, K. L., Iwanaga, T., Watanabe, A., Yokoi, N., Tabuchi, K., Shigemoto, R., Nicoll, R. A., Fukata, M., 2010. Disruption of LGI1-linked synaptic complex causes abnormal synaptic transmission and epilepsy. Proc. Natl. Acad. Sci. U.S.A. 107(8), 3799-3804.

Furlan, S., Roncaroli, F., Forner, F., Vitiello, L., Calabria, E., Piquer-Sirerol, S., Valle, G., Perez-Tur, J., Michelucci, R., Nobile, C., 2006. The LGI1/epitempin gene encodes two protein isoforms differentially expressed in human brain. J. Neurochem. 98(3), 985-991.

Glick, S. D., Ross, D. A., 1981. Lateralization of function in the rat brain: Basic mechanisms may be operative in humans. Trends Neurosci. 4, 196-199.

Hanaya, R., Hosoyama, H., Sugata, S., Tokudome, M., Hirano, H., Tokimura, H., Kurisu, K., Serikawa, T., Sasa, M., Arita, K., 2012. Low distribution of synaptic vesicle protein 2A and synaptotagimin-1 in the cerebral cortex and hippocampus of spontaneously epileptic rats exhibiting both tonic convulsion and absence seizure. Neuroscience 221, 12-20.

Herranz-Perez, V., Olucha-Bordonau, F. E., Morante-Redolat, J. M., Perez-Tur, J., 2010. Regional distribution of the leucine-rich glioma inactivated (LGI) gene family transcripts in the adult mouse brain. Brain Res. 1307, 177-194.

Kalachikov, S., Evgrafov, O., Ross, B., Winawer, M., Barker-Cummings, C., Martinelli Boneschi, F., Choi, C., Morozov, P., Das, K., Teplitskaya, E., 2002. Mutations in LGI1 cause autosomal-dominant partial epilepsy with auditory features. Nat. Genet. 30(3), 335-341.

Kawamata, J., Ikeda, A., Fujita, Y., Usui, K., Shimohama, S., Takahashi, R., 2009. Mutations in LGI1 gene in Japanese families with autosomal dominant lateral temporal lobe epilepsy: the first report from Asian families. Epilepsia 51(4), 690-693.

Kobayashi, E., Santos, N. F., Torres, F. R., Secolin, R., Sardinha, L. A. C., Lopez-Cendes, I., Cendes, F., 2003. Magnetic resonance imaging abnormalities in familial temporal lobe epilepsy with auditory auras. Arch Neurol. 60(11), 1546-1551.

Mashimo, T., Ohmori, I., Ouchida, M., Ohno, Y., Tsurumi, T., Miki, T., Wakamori, M., Ishihara, S., Yoshida, T., Takizawa, A., Kato, M., Hirabayashi, M., Sasa, M., Mori, Y., Serikawa, T., 2010. A missense

mutation of the gene encoding voltage-dependent sodium channel (Nav1.1) confers susceptibility to febrile seizures in rats. J. Neurosci. 30(16), 5744-5753.

Michelucci, R., Mecarelli, O., Bovo, G., Bisulli, F., Testoni, S., Striano, P., Striano, S., Tinuper, P., Nobile, C., 2007. A de novo LGI1 mutation causing idiopathic partial epilepsy with telephone-induced seizures. Neurology 68(24), 2150-2151.

Michelucci, R., Pasini, E., Nobile, C., 2009. Lateral temporal lobe epilepsies: clinical and genetic features. Epilepsia 50 Suppl 5, 52-54.

Michelucci, R., Poza, J. J., Sofia, V., de Feo, M. R., Binelli, S., Bisulli, F., Scudellaro, E., Simionati, B., Zimbello, R., D'Orsi, G., Passarelli, D., Avoni, P., Avanzini, G., Tinuper, P., Biondi, R., Valle, G., Mautner, V. F., Stephani, U., Tassinari, C. A., Moschonas, N. K., Siebert, R., Lopez de Munain, A., Perez-Tur, J., Nobile, C.,2003. Autosomal dominant lateral temporal epilepsy: clinical spectrum, new epitempin mutations, and genetic heterogeneity in seven European families. Epilepsia 44(10), 1289-1297.

Morante-Redolat, J. M., Gorostidi-Pagola, A., Piquer-Sirerol, S., Sáenz, A., Poza, J. J., Galán, J., Gesk, S., Sarafidou, T., Mautner, V., Binelli, S., 2002. Mutations in the LGI1/Epitempin gene on 10q24 cause autosomal dominant lateral temporal epilepsy. Hum. Mol. Genet. 11(9), 1119-1128.

Nobile, C., Michelucci, R., Andreazza, S., Pasini, E., Tosatto, S. C. E., Striano, P., 2009. LGI1 mutations in autosomal dominant and sporadic lateral temporal epilepsy. Hum. Mutat. 30(4), 530-536.

Ohno, Y., Shimizu, S., Harada, Y., Morishita, M., Ishihara, S., Kumafuji, K., Sasa, M., Serikawa, T., 2009. Regional expression of Fos-like immunoreactivity following seizures in Noda epileptic rat (NER). Epilepsy Res. 87(1), 70-76.

Ottman, R., Risch, N., Hauser, W. A., Pedley, T. A., Lee, J. H., Barker-Cummings, C., Lustenberger, A., Nagle, K. J., Lee, K.S., Scheuer, M. L., Neystat, M., Susser, M., Wilhelmsen, K. C., 1995. Localization of a gene for partial epilepsy to chromosome 10q. Nat. Genet. 10, 56-60.

Ottman, R., Winawer, M. R., Kalachikov, S., Barker-Cummings, C., Gilliam. T. C., Pedley. T. A., Hauser, W. A., 2004. LGI1 mutations in autosomal dominant partial epilepsy with auditory features. Neurology 62(7), 1120-1126.

Paxinos, G., Watson, C., 2007. The Rat Brain in Stereotaxic Coordinates, 6th ed. Academic Press, Amsterdam

Rakhade, S. N., Shah, A. K., Agarwal, R., Yao, B., Asano, E., Loeb, J. A., 2007. Activity-dependent gene expression correlates with interictal spiking in human neocortical epilepsy. Epilepsia 48(Suppl. 5), 86-95.

Senechal, K. R., Thaller, C., Noebels, J. L., 2005. ADPEAF mutations reduce levels of secreted LGI1, a putative tumor suppressor protein linked to epilepsy. Hum. Mol. Genet. 14(12), 1613-1620.

Striano, P., Busolin, G., Santulli, L., Leonardi, E., Coppola, A., Vitiello, L., Rigon, L., Michelucci, R., Tosatto, S. C. E., Striano, S., Nobile, C., 2011. Familial temporal lobe epilepsy with psychic auras associated with a novel LGI1 mutation. Neurology 76(13), 1173-1176.

Romijn, H. J., Hofman, M. A., Gramsbergen, A., 1991. At what age is the developing cerebral cortex of the rat comparable to that of the full-term newborn human baby? Early Hum. Dev. 26(1), 61-67.

Tessa, C., Michelucci, R., Nobile, C., Giannelli, M., Della Nave, R., Testoni, S., Bianucci, D., Tinuper, P., Bisulli, F., Sofia, V., De Feo, M. R., Giallonardo, A. T., Tassinari, C. A., Mascalchi, M.,2007. Structural anomaly of left lateral temporal lobe in epilepsy due to mutated LGI1. Neurology 69(12), 1298-1300.

Valjakka, A., Jaakkola, M., Vartiainen, J., Olkkonen, H., Semiokhina, A., Fedotova, I., Virkkala, J., Ylikoski, J., Tuomisto, L., 2000. The relationship between audiogenic seizure (AGS) susceptibility and forebrain tone-responsiveness in genetically AGS-prone Wistar rats. Physiol. Behav. 70(3–4), 297-309.

Vinogradova, L. V., 2010. Interhemispheric difference in susceptibility to epileptogenesis: evidence from the audiogenic kindling model in Wistar rats. Brain Res. 1329, 175-181.

Winawer, M. R., Ottman, R., Hauser, W. A., Pedley, T. A., 2000. Autosomal dominant partial epilepsy with auditory features: defining the phenotype. Neurology 54(11), 2173-2176.

Winden, K. D., Karsten, S. L., Bragin, A., Kudo, L. C., Gehman, L., Ruidera, J., Geschwind, D. H., Engel, J., 2011. A systems level, functional genomics analysis of chronic epilepsy. PLoS ONE 6(6), e20763.

Yamada, M., Takeshita, T., Miura, S., Murata, K., Kimura, Y., Ishii, N., Nose, M., Sakagami, H., Kondo, H., Tashiro, F., Miyazaki, J.-I., Sasaki, H.,

Sugamura, K., 2001. Loss of Hippocampal CA3 Pyramidal Neurons in Mice Lacking STAM1. Mol. Cell. Biol. 21(11), 3807-3819.

Yu, Y. E., Wen, L., Silva, J., Li, Z., Head, K., Sossey-Alaoui, K., Pao, A., Mei, L., Cowell, J. K., 2010. Lgi1 null mutant mice exhibit myoclonic seizures and CA1 neuronal hyperexcitability. Hum. Mol. Genet. 19(9), 1702-1711.

Figure Legends

Fig. 1. EEG during audiogenic seizures. (A) *Lgi1*$^{L385R/+}$ rats and WTs are divided into 3 groups: A (no auditory stimulation), B (acoustic priming stimulus only), and C (acoustic priming and test stimuli). (B) Behavior following acoustic test stimulation in group C rats. All *Lgi1*$^{L385R/+}$ rats showed wild running behavior and GTCS while all WT rats showed only wild running. (C) Placement of electrodes. Red asterisks, bipolar electrode in the left lateral temporal lobe; monopolar electrode in the right lateral temporal lobe or left frontal lobe. Blue asterisk: indifferent electrode in right frontal area of cranium. (D) EEG recording during audiogenic seizure. Slow (5–7 Hz) rhythmic activity was followed by rhythmic spikes. (E, F) EEG of *Lgi1*$^{L385R/+}$ rat with wild running and GTCS. There was no notable time lag between temporal lobes (E) or between the left lateral temporal lobe and the left frontal lobe (F) in onset of either wild running (blue arrow) or GTCS (purple arrow). GTCS, generalized tonic-clonic seizures.

Fig. 2. Fos immunohistochemistry. Results presented are from the right hemisphere. (A) Brain regions (black squares) selected for quantitative analysis of Fos-IR cells; cited from Ohno et al. (2009). Anteroposterior coordinates (distance from Bregma) are shown above each brain section. (B) Fos-IR cell numbers in WT vs. *Lgi1*$^{L385R/+}$ rats in group A. (C) Fos-IR cell numbers in *Lgi1*$^{L385R/+}$ rats, group B vs. group C. Results demonstrate a marked general elevation of Fos-IR cell numbers in group C compared to

group B, as well as significant increases in AuC, LHb, Pt, AM, AH, PH, DMH, Pir2 and CA3. **(D)** Fos-IR cell numbers in WT rats, group B vs. group C. Fos immunoreactivity is similar in most subregions except CA2 and PH, where it is significantly higher in group C. **(E)** Fos-IR cell numbers in *Lgi1*$^{L385R/+}$ rats, group A vs. group B. Results demonstrate reduced Fos immunoreactivity in CgC and dmST after priming stimulation. **(F)** Fos-IR in WT rats, group A vs. group B. A general elevation in Fos-IR cell numbers is seen in group B, with significant differences in mPFC, MC3, SC2, SC3, Pir2, PRh-Ent, CA2, PMCo, PT, VM and PH. Data are expressed as mean ± S.E.M. Student *t*-test, $*p < 0.05$; $**p < 0.01$. AcC, nucleus accumbens core; AcS, nucleus accumbens shell AH, anterior hypothalamus; AIC, agranular insular cortex; AM, anteromedial thalamus; AuC, auditory cortex; BMA, basomedial amygdaloid nucleus; Cg, cingulate cortex; CM, centromedial thalamus; DG, dentate gyrus of the hippocampus; dlST, dorsolateral striatum; DMH, dorsomedial hypothalamus; dmST, dorsomedial striatum; Fos-IR, Fos-like immunoreactive; GP, globus pallidus; LaVM, lateral amygdaloid nucleus ventromedialis; LHb, lateral habenula; LS, lateral septum; MC, motor cortex; mPFC, medial prefrontal cortex; PH, posterior hypothalamus; Pir, piriform cortex; PMCo, posteromedial cortical amygdaloid nucleus; PRh-Ent, perirhinal-entorhinal cortex; PT, paratenial thalamus; SC, sensory cortex; VM, ventromedial thalamus.

Fig. 3. Microarray analysis.

Scatter plot analysis of gene expression in (A) WT and (B) *Lgi1*$^{L385R/+}$ rats in group B vs. group C. Upregulated genes are identifiable as a leftward shift from the correlation line, and downregulated genes as a rightward shift. (C) Genes were divided into 8 groups by patterns of expression changes in group C compared with group B. ↑, upregulated gene expression in group C compared with group B (≥ twofold); ↓, downregulated gene expression in group C compared with group B (≤ half); →, gene expression in group C within 0.5–2 times that in group B; *Lgi1*, *Lgi1*$^{L385R/+}$ rats; F344, WT rats; *Epilepsy-related genes (see Table S2).

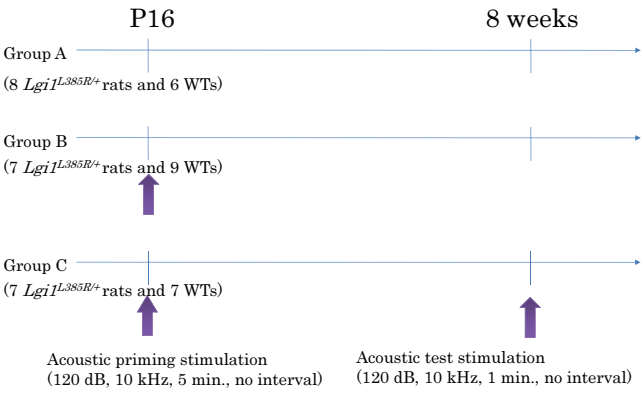
Table 1. Expression of *Lgi1* and 16 related genes. No significant differences were seen in mRNA expression between genotype or acoustic stimulus group. The gScale signal value of *LGI1* and related genes are given.

Table S1 Genes whose mRNA expression doubled or halved in secondary acoustic stimuli.

Table S2. Examples of epilepsy-related genes with differential expression between group B (priming stimulation only) and group C (priming

stimulation and test stimulation-induced audiogenic seizures). Genes were found using PubMed, Sciverse Scopus and Web of Science, with the search terms 'epilepsy and [gene name]'.

A

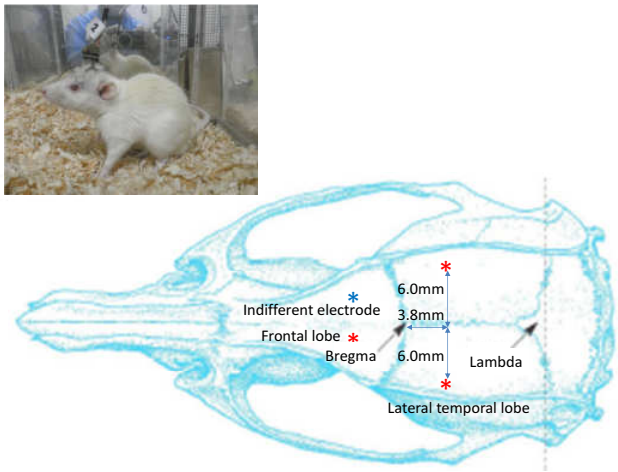


B

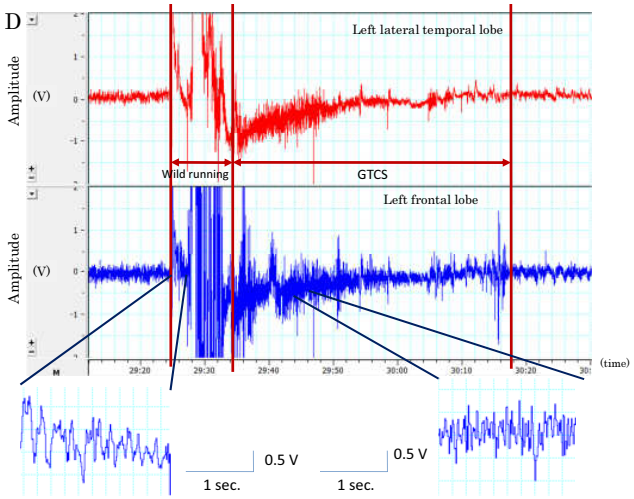
Acoustic test stimulation in group C rats.

	wild running only n(%)	wild running + GTCS n(%)
WTs (n=7)	7 (100%)	0 (0%)
Lgi1$^{L385R/+}$ rats (n=7)	0 (0%)	7 (100%)

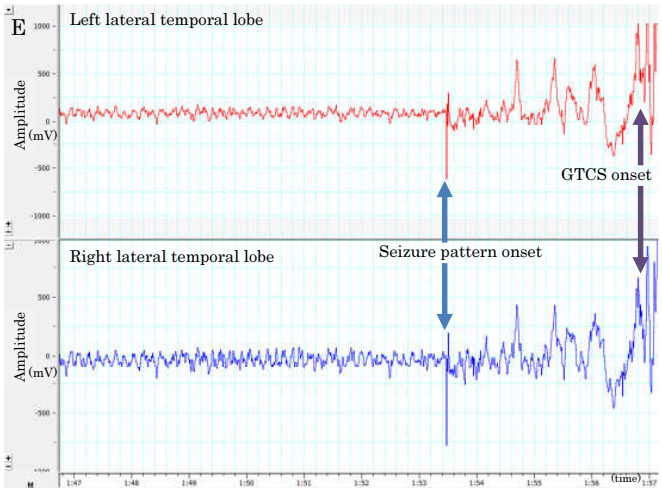
C



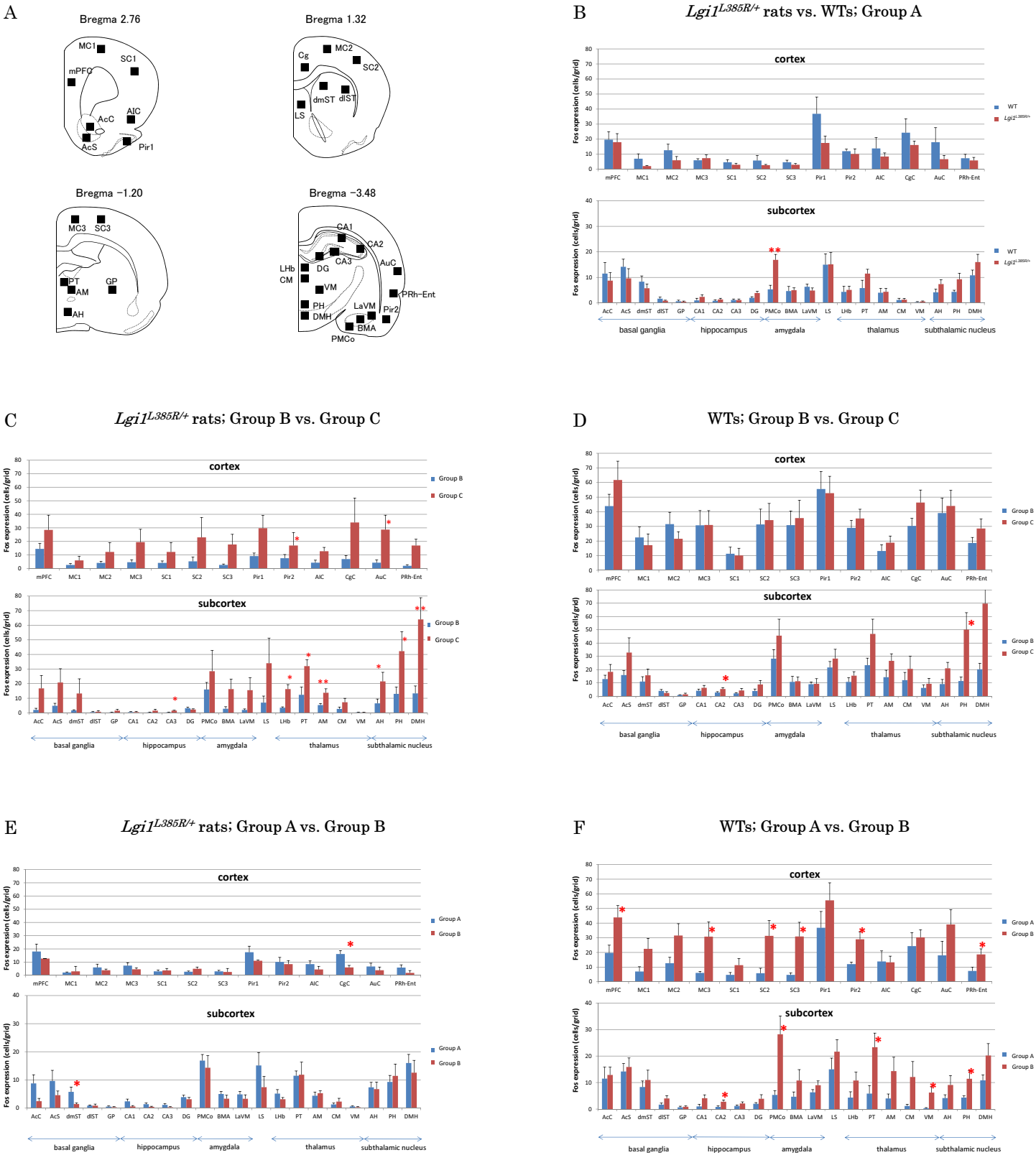
D



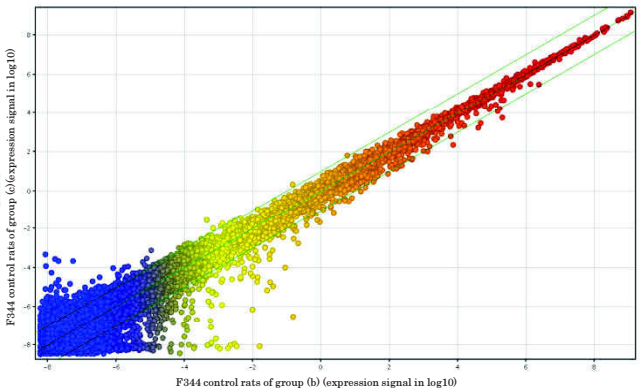
E



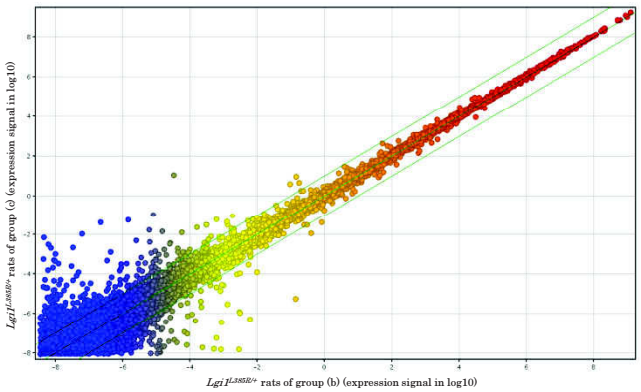
F


A
Bregma 2.76
MC1
SC1
mPFC
AcC
AIC
AcS
Pir1
Bregma 1.32
Cg
MC2
SC2
dmST
dlST
LS
Bregma −1.20
MC3
SC3
PT
GP
AM
AH
Bregma −3.48
CA1
CA2
CA3
AuC
LHb
DG
CM
VM
PRh-Ent
PH
LaVM
Pir2
DMH
BMA
PMCo
B
Lgi1L385R/+ rats vs. WTs; Group A
cortex
subcortex
Fos expression (cells/grid)
WT
Lgi1L385R/+
mPFC MC1 MC2 MC3 SC1 SC2 SC3 Pir1 Pir2 AIC CgC AuC PRh-Ent
AcC AcS dmST dlST GP CA1 CA2 CA3 DG PMCo BMA LaVM LS LHb PT AM CM VM AH PH DMH
basal ganglia
hippocampus
amygdala
thalamus
subthalamic nucleus
C
Lgi1L385R/+ rats; Group B vs. Group C
Group B
Group C
D
WTs; Group B vs. Group C
E
Lgi1L385R/+ rats; Group A vs. Group B
Group A
Group B
F
WTs; Group A vs. Group B

A


F344 control rats of group (c) (expression signal in log10)
F344 control rats of group (b) (expression signal in log10)

B


Lgi1L385R/+ rats of group (c) (expression signal in log10)
Lgi1L385R/+ rats of group (b) (expression signal in log10)

C

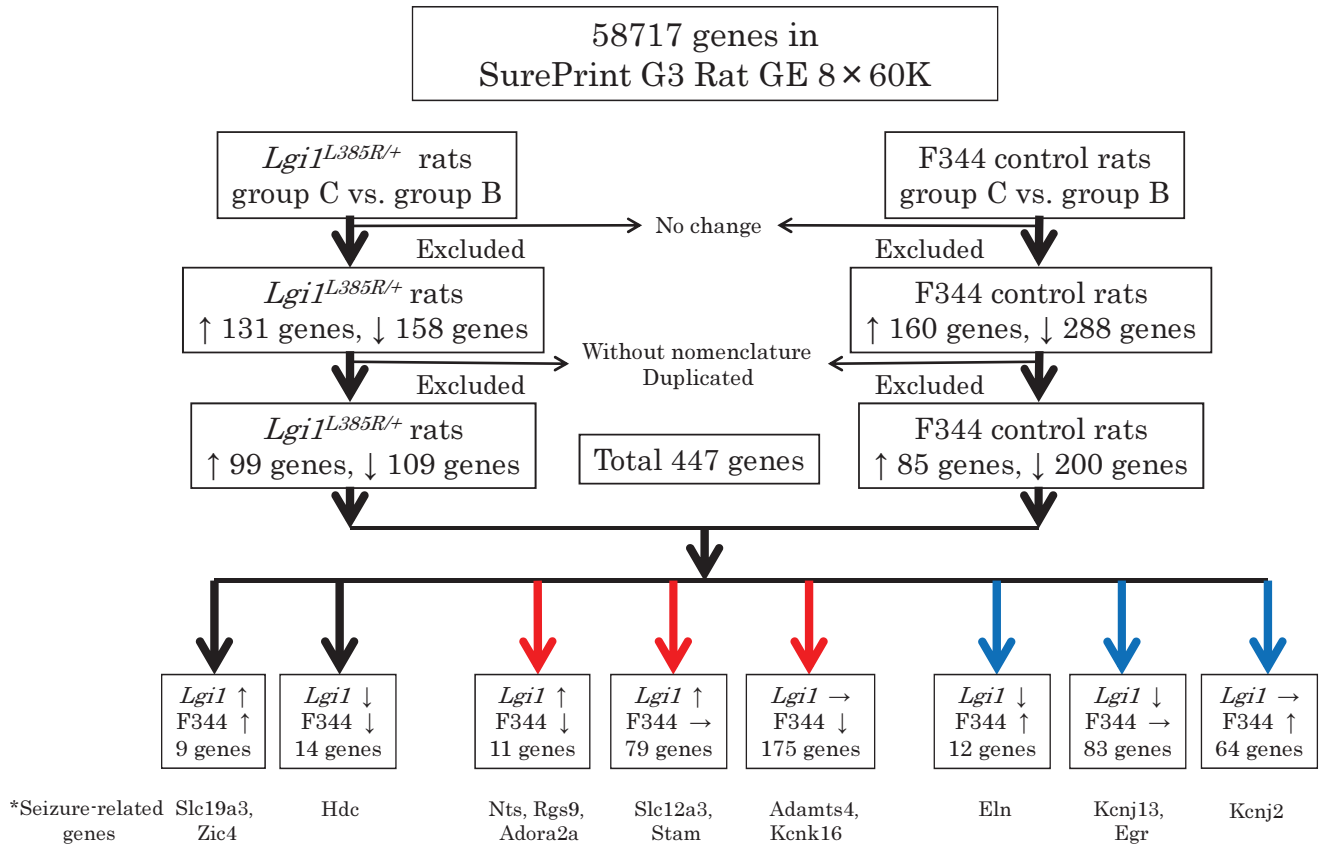

58717 genes in SurePrint G3 Rat GE 8×60K
Lgi1L385R/+ rats group C vs. group B
F344 control rats group C vs. group B
No change
Excluded
Excluded
Lgi1L385R/+ rats ↑ 131 genes, ↓ 158 genes
F344 control rats ↑ 160 genes, ↓ 288 genes
Without nomenclature Duplicated
Excluded
Excluded
Lgi1L385R/+ rats ↑ 99 genes, ↓ 109 genes
Total 447 genes
F344 control rats ↑ 85 genes, ↓ 200 genes
Lgi1 ↑ F344 ↑ 9 genes
Lgi1 ↓ F344 ↓ 14 genes
Lgi1 ↑ F344 ↓ 11 genes
Lgi1 ↑ F344 → 79 genes
Lgi1 → F344 ↓ 175 genes
Lgi1 ↓ F344 ↑ 12 genes
Lgi1 ↓ F344 → 83 genes
Lgi1 → F344 ↑ 64 genes
*Seizure-related genes
Slc19a3, Zic4
Hdc
Nts, Rgs9, Adora2a
Slc12a3, Stam
Adamts4, Kcnk16
Eln
Kcnj13, Egr
Kcnj2

Table 1. Expression of Lgi1 and 16 related genes. No significant differences were seen in mRNA expression between genotype or acoustic stimulus group.

Gene symbol	Gene name	gScale signal			
		Lgi1 mutant		WT	
		Group B	Group C	Group B	Group C
Lgi1	leucine-rich, glioma inactivated 1	1047.6	1033.8	1123.0	1075.7
Lgi2	leucine-rich repeat LGI family, member 2	381.1	298.9	370.9	340.9
Lgi3	leucine-rich repeat LGI family, member 3	28313.2	19155.6	26228.8	25912.3
Lgi4	leucine-rich repeat LGI family, member 4	5345.1	4658.4	5206.1	5781.8
ADAM11	ADAM metallopeptidase domain 11	430.8	404.7	387.3	421.2
ADAM22	ADAM metallopeptidase domain 22	654.0	583.6	625.2	682.4
ADAM23	ADAM metallopeptidase domain 23	465.8	473.2	456.0	486.9
KCNA1	potassium voltage-gated channel, shaker-related subfamily, member 1	17030.6	13007.3	16030.4	16952.0
KCNA4	potassium voltage-gated channel, shaker-related subfamily, member 4	536.9	571.7	565.0	506.7
KCNAB1	potassium voltage-gated channel, shaker-related subfamily, beta member 1	3444.3	3663.0	3486.2	3907.2
PDYN	prodynorphin	3393.1	3385.6	3277.4	3112.7
GRIA2	glutamate receptor, ionotropic, AMPA 2	3345.2	3932.1	3636.1	3512.4
GRIA3	glutamate receptor, ionotropic, AMPA 3	24599.7	28802.5	25026.8	23864.9
GABBR1	gamma-aminobutyric acid (GABA) B receptor, 1	3908.2	4146.3	4031.5	4063.9
RAF1	v-raf-1 murine leukemia viral oncogene homolog 1	1724.7	1769.1	1752.3	1747.0
AKT1	v-akt murine thymoma viral oncogene homolog 1	2148.3	2140.0	2286.7	2264.4
RTN4r	reticulon 4 receptor	4808.4	5395.3	5311.4	5100.4

Table S1. Genes whose mRNA expression doubled or halved in secondary acoustic stimuli.

Probe Name	*Lgi1* (C vs B)	WT (C vs B)	Gene Symbol	Description	Chromo-some No. Avadis	Gene Name
A_64_P086244	4.82	1.10	Tll2	Rattus norvegicus tolloid-like 2 (Tll2), mRNA [NM_001191898]	chr1	tolloid-like 2
A_64_P002285	2.10	1.09	LOC679087	PREDICTED: Rattus norvegicus similar to swan (LOC679087), mRNA [XM_001054639]	chr5	similar to swan
A_64_P080370	1.84	2.09	Vom2r73	Rattus norvegicus vomeronasal 2 receptor, 73 (Vom2r73), mRNA [NM_001099486]	chr14	vomeronasal 2 receptor, 73
A_64_P112305	1.49	1.05	LOC497860	Rattus norvegicus similar to RIKEN cDNA 4930517K11 (LOC497860), mRNA [NM_001195471]	chr10	similar to RIKEN cDNA 4930517K11
A_64_P008166	1.43	2.02	Slc19a3	Rattus norvegicus solute carrier family 19, member 3 (Slc19a3), mRNA [NM_001108228]	chr9	solute carrier family 19, member 3
A_44_P1055780	1.28	1.87	S100a8	Rattus norvegicus S100 calcium binding protein A8 (S100a8), mRNA [NM_053822]	chr2	S100 calcium binding protein A8
A_64_P065037	1.12	2.37	Plagl2	pleiomorphic adenoma gene-like 2 [Source:RefSeq peptide;Acc:NP_001099998] [ENSRNOT00000013383]	chr3	pleiomorphic adenoma gene-like 2
A_64_P060038	1.07	1.62	Hmgb1-ps2	Rattus norvegicus high mobility group box 1, pseudogene 2 (Hmgb1-ps2), non-coding RNA [NR_024023]	chr17	high mobility group box 1, pseudogene 2
A_44_P659117	1.07	1.14	Zic4	Rattus norvegicus Zic family member 4 (Zic4), mRNA [NM_001108176]	chr8	Zic family member 4
A_44_P605002	-4.49	-1.17	Slc45a4	PREDICTED: Rattus norvegicus solute carrier family 45, member 4, transcript variant 2 (Slc45a4), mRNA [XM_002726935]	chr7	solute carrier family 45, member 4
A_64_P122489	-2.02	-3.03	Hdc	Rattus norvegicus histidine decarboxylase (Hdc), mRNA [NM_017016]	chr3	histidine decarboxylase
A_64_P098515	-1.64	-2.57	LOC680885	Rattus norvegicus hypothetical protein LOC680885 (LOC680885), mRNA [NM_001109431]	chr16	hypothetical protein LOC680885
A_44_P177857	-1.39	-3.33	Ttll2	Rattus norvegicus tubulin tyrosine ligase-like family, member 2 (Ttll2), mRNA [NM_001169136]	chr1	tubulin tyrosine ligase-like family, member 2
A_64_P037883	-1.35	-1.91	Tctex1d4	PREDICTED: Rattus norvegicus Tctex1 domain containing 4 (Tctex1d4), mRNA [XM_001071721]	chr5	Tctex1 domain containing 4
A_64_P072900	-1.15	-1.74	Astl	Rattus norvegicus astacin-like metalloendopeptidase (M12 family) (Astl), mRNA [NM_001106504]	chr3	astacin-like metalloendopeptidase (M12 family)
A_64_P147569	-1.14	-2.58	RGD1563200	Rattus norvegicus similar to CDNA sequence BC048502 (RGD1563200), mRNA [NM_001109288]	chr7	similar to CDNA sequence BC048502
A_64_P057513	-1.11	-1.53	RGD1566368	Uncharacterized protein [Source:UniProtKB/TrEMBL;Acc:F1LZT7] [ENSRNOT00000008172]	chr8	similar to Solute carrier family 6 (neurotransmitter transporter), member 20
A_64_P054112	-1.11	-1.96	T	Rattus norvegicus T, brachyury homolog (mouse) (T), mRNA [NM_001106209]	chr1	T, brachyury homolog (mouse)
A_43_P15474	-1.11	-1.22	Spef2	Rattus norvegicus sperm flagellar 2 (Spef2), mRNA [NM_022620]	chr2	sperm flagellar 2
A_64_P146444	-1.09	-2.85		Rattus norvegicus similar to Spindlin-like protein 2 (SPIN-2) (LOC301882), mRNA [XM_229364]	chr16	similar to Spindlin-like protein 2 (SPIN-2)
A_44_P412647	-1.06	-1.42	Gins2	Rattus norvegicus GINS complex subunit 2 (Psf2 homolog) (Gins2), mRNA [NM_001106190]	chr19	GINS complex subunit 2 (Psf2 homolog)

A_64_P101425	-1.06	-3.03	RGD1560137	PREDICTED: Rattus norvegicus similar to expressed sequence AU021034 (RGD1560137), miscRNA [XR_008828]	chr15	similar to expressed sequence AU021034
A_43_P12619	-1.01	-1.02	Nr4a3	Rattus norvegicus nuclear receptor subfamily 4, group A, member 3 (Nr4a3), transcript variant 1, mRNA [NM_031628]	chr5	nuclear receptor subfamily 4, group A, member 3
A_44_P1030165	2.36	-4.74	Nts	Rattus norvegicus neurotensin (Nts), mRNA [NM_001102381]	chr7	neurotensin
A_44_P1019604	2.17	-3.61	Ube2c	Rattus norvegicus ubiquitin-conjugating enzyme E2C (Ube2c), mRNA [NM_001106542]	chr3	ubiquitin-conjugating enzyme E2C
A_44_P430547	2.17	-1.75	Ntrk1	Rattus norvegicus neurotrophic tyrosine kinase, receptor, type 1 (Ntrk1), mRNA [NM_021589]	chr2	neurotrophic tyrosine kinase, receptor, type 1
A_64_P132856	2.11	-2.62	Lhx8	Rattus norvegicus LIM homeobox 8 (Lhx8), mRNA [NM_001012219]	chr2	LIM homeobox 8
A_44_P637087	1.80	-2.94	Fam178b	Rattus norvegicus family with sequence similarity 178, member B (Fam178b), mRNA [NM_001122658]	chr9	family with sequence similarity 178, member B
A_43_P11983	1.79	-1.14	Rgs9	Rattus norvegicus regulator of G-protein signaling 9 (Rgs9), mRNA [NM_019224]	chr10	regulator of G-protein signaling 9
A_64_P121932	1.77	-1.23	Spag6l	Rattus norvegicus sperm associated antigen 6-like (Spag6l), mRNA [NM_001106125]	chr17	sperm associated antigen 6-like
A_64_P158693	1.18	-1.13	LOC367436	Rattus norvegicus similar to Y-LINKED TESTIS-SPECIFIC PROTEIN (LOC367436), mRNA [XM_346138]	chrUn	similar to Y-linked testis-specific protein
A_44_P1034950	1.69	-1.71	Adora2a	Rattus norvegicus adenosine A2a receptor (Adora2a), mRNA [NM_053294]	chr20	adenosine A2a receptor
A_42_P676553	1.25	-1.13	Tnni3	Rattus norvegicus troponin I type 3 (cardiac) (Tnni3), mRNA [NM_017144]	chr1	troponin I type 3 (cardiac)
A_64_P116013	1.18	-2.70	LOC686907	PREDICTED: Rattus norvegicus similar to cis-Golgi matrix protein GM130, transcript variant 2 (LOC686907), mRNA [XM_001076221]	chr3	similar to cis-Golgi matrix protein GM130
A_64_P395299	6.18	<±1.00	Dnah17	Uncharacterized protein [Source:UniProtKB/TrEMBL;Acc:D4A2Y8] [ENSRNOT00000004047]	chr10	dynein, axonemal, heavy chain 17
A_43_P22761	5.69	<±1.00	Spaca5	Rattus norvegicus sperm acrosome associated 5 (Spaca5), mRNA [NM_001108058]	chrUn	sperm acrosome associated 5
A_64_P009117	5.49	<±1.00	LOC686388	PREDICTED: Rattus norvegicus similar to Prostatic steroid-binding protein C1 chain precursor (Prostatein peptide C1) (LOC686388), mRNA [XM_001073908]	chr1	similar to Prostatic steroid-binding protein C1 chain precursor
A_64_P134674	5.24	<±1.00	Adad2	PREDICTED: Rattus norvegicus similar to testis nuclear RNA-binding protein (LOC691275), mRNA [XM_002725395]	chr19	adenosine deaminase domain containing 2
A_44_P690802	4.76	<±1.00	LOC498236	Rattus norvegicus LRRGT00186 (LOC498236), mRNA [NM_001047926]	chr13	LRRGT00186
A_64_P051957	4.66	<±1.00	Olr670	Rattus norvegicus olfactory receptor 670 (Olr670), mRNA [NM_001000633]	chr3	oxidized low density lipoprotein (lectin-like) receptor 670
A_64_P004062	4.41	<±1.00	Olr250	Rattus norvegicus olfactory receptor 250 (Olr250), mRNA [NM_001001037]	chr1	olfactory receptor 250
A_64_P036820	4.41	<±1.00	Fam109b	Rattus norvegicus family with sequence similarity 109, member B (Fam109b), mRNA [NM_001130511]	chr7	family with sequence similarity 109, member B
A_44_P546117	4.10	<±1.00	LOC361346	Rattus norvegicus similar to chromosome 18 open reading frame 54 (LOC361346), mRNA [NM_001017462]	chr18	similar to chromosome 18 open reading frame 54
A_44_P401110	3.38	<±1.00	Tesp2	Rattus norvegicus testicular serine protease 2 (Tesp2), mRNA [NM_001108209]	chr9	testicular serine protease 2

A_44_P480852	3.28	<±1.00	RGD1565947	Rattus norvegicus similar to netrin 4 (RGD1565947), mRNA [NM_001106780]	chr7	similar to netrin 4
A_64_P063716	3.04	<±1.00	RGD1561766	PREDICTED: Rattus norvegicus similar to basic transcription factor 3 (RGD1561766), miscRNA [XR_009374]	chr3	similar to basic transcription factor 3
A_44_P137497	2.97	<±1.00		Rattus norvegicus Ac1-283 mRNA, complete cds. [AY325224]	chr7	Ac1-283
A_44_P288359	2.91	<±1.00		Rattus norvegicus similar to Translationally controlled tumor protein (TCTP) (p23) (21 kDa polypeptide) (p21) (Lens epithelial protein) (LOC289930), mRNA [XM_223826]	chr15	similar to Translationally controlled tumor protein (TCTP) (p23) (21 kDa polypeptide) (p21) (Lens epithelial protein)
A_64_P112889	2.81	<±1.00	Ccdc152	Rattus norvegicus coiled-coil domain containing 152 (Ccdc152), mRNA [NM_001191959]	chr2	coiled-coil domain containing 152
A_64_P112291	2.74	<±1.00	Slc1a7	Rattus norvegicus solute carrier family 1 (glutamate transporter), member 7 (Slc1a7), mRNA [NM_001108973]	chr5	solute carrier family 1 (glutamate transporter), member 7
A_64_P087698	2.71	<±1.00	LOC499542	Rattus norvegicus LRRGT00178 (LOC499542), mRNA [NM_001047943]	chr2	LRRGT00178
A_64_P109844	2.41	<±1.00	Anubl1	AN1-type zinc finger and ubiquitin domain-containing protein 1 [Source:RefSeq peptide;Acc:NP_775454] [ENSRNOT00000043556]	chr4	AN1-type zinc finger and ubiquitin domain-containing protein 1
A_64_P081581	2.36	<±1.00	Zc3h12d	Rattus norvegicus zinc finger CCCH type containing 12D (Zc3h12d), mRNA [NM_001107469]	chr1	zinc finger CCCH-type containing 12D
A_44_P166418	2.34	<±1.00	Samd11	RCG31097, isoform CRA_aUncharacterized protein [Source:UniProtKB/TrEMBL;Acc:D3ZMX5] [ENSRNOT00000027564]	chr5	sterile alpha motif domain containing 11
A_64_P058297	2.32	<±1.00	Tex28	Rattus norvegicus testis expressed 28 (Tex28), mRNA [NM_001191103]	chrX	testis expressed 28
A_64_P090851	2.27	<±1.00	Zfp521	zinc finger protein 521 [Source:RefSeq peptide;Acc:NP_001100873] [ENSRNOT00000022637]	chr18	zinc finger protein 421 homolog
A_44_P976680	2.26	<±1.00	Cenpw	Centromere protein W [Source:UniProtKB/Swiss-Prot;Acc:A1L1L1] [ENSRNOT00000065677]	chr1	Centromere protein W
A_64_P154646	2.20	<±1.00	Slc7a15	Rattus norvegicus solute carrier family 7 (cationic amino acid transporter, y+ system), member 15 (Slc7a15), mRNA [NM_001106714]	chr6	solute carrier family 7 (cationic amino acid transporter, y+ system), member 15
A_64_P236835	2.15	<±1.00	Ccdc96	Uncharacterized protein [Source:UniProtKB/TrEMBL;Acc:D3Z9F2] [ENSRNOT00000008601]	chr14	coiled-coil domain containing 96
A_64_P113179	2.15	<±1.00	Stk32a	Rattus norvegicus serine/threonine kinase 32A (Stk32a), mRNA [NM_001191894]	chr18	serine/threonine kinase 32A
A_64_P066493	2.12	<±1.00	LOC100359653	PREDICTED: Rattus norvegicus rCG43168-like (LOC100359653), mRNA [XM_002728431]	chr16	rCG43168-like
A_44_P192010	1.98	<±1.00	Tubgcp5	Rattus norvegicus tubulin, gamma complex associated protein 5 (Tubgcp5), mRNA [NM_001107516]	chr1	tubulin, gamma complex associated protein 5
A_44_P937601	1.98	<±1.00		O16480_CAEEL (O16480) Serpentine receptor, class t protein 8, partial (5%) [TC627292]	chr15	Serpentine receptor, class t protein 8
A_44_P993051	1.98	<±1.00	Bpifa1	Rattus norvegicus palate, lung and nasal epithelium associated (Plunc), mRNA [NM_172031]	chr3	BPI fold containing family A, member 1
A_64_P017631	1.97	<±1.00	RGD1563669	Rattus norvegicus similar to Mediator of RNA polymerase II transcription, subunit 9 homolog (RGD1563669), mRNA [NM_001127302]	chr10	similar to Mediator of RNA polymerase II transcription, subunit 9 homolog

A_64_P084054	1.91	<±1.00	Lrrc10b	Rattus norvegicus leucine rich repeat containing 10B (Lrrc10b), mRNA [NM_001107577]	chr1	leucine rich repeat containing 10B
A_64_P116606	1.88	<±1.00	Rcan1	Rattus norvegicus regulator of calcineurin 1 (Rcan1), mRNA [NM_153724]	chr11	regulator of calcineurin 1
A_64_P058809	1.79	<±1.00	Zfp469	Rattus norvegicus zinc finger protein 469 (Zfp469), mRNA [NM_001107123]	chr12	zinc finger protein 469 homolog
A_44_P393985	1.73	<±1.00		Rattus norvegicus similar to cytoplasmic beta-actin (LOC298169), mRNA [XM_233107]	chrX	similar to cytoplasmic beta-actin
A_64_P022452	1.72	<±1.00	Pebp4	PREDICTED: Rattus norvegicus phosphatidylethanolamine binding protein 4 (Pebp4), mRNA [XM_001080758]	chr15	phosphatidylethanolamine-binding protein 4
A_64_P160774	1.70	<±1.00	Zkscan2	Uncharacterized protein [Source:UniProtKB/TrEMBL;Acc:D3ZXU0] [ENSRNOT00000020281]	chr1	zinc finger with KRAB and SCAN domains 2
A_64_P149869	1.70	<±1.00	Vit	Uncharacterized protein [Source:UniProtKB/TrEMBL;Acc:F1M095] [ENSRNOT00000006360]	chr6	vitrin
A_64_P097824	1.68	<±1.00		PREDICTED: Rattus norvegicus similar to hypothetical protein 4932411N23 (RGD1561151), mRNA [XM_001066024]	chrX	similar to hypothetical protein 4932411N23
A_44_P353618	1.67	<±1.00	S100a9	Rattus norvegicus S100 calcium binding protein A9 (S100a9), mRNA [NM_053587]	chr2	S100 calcium binding protein A9
A_43_P23118	1.66	<±1.00	Igfbpl1	Rattus norvegicus insulin-like growth factor binding protein-like 1 (Igfbpl1), mRNA [NM_001108972]	chr5	insulin-like growth factor binding protein-like 1
A_44_P552830	1.63	<±1.00	A3galt2	Rattus norvegicus alpha 1,3-galactosyltransferase 2 (A3galt2), mRNA [NM_138524]	chr5	alpha 1,3-galactosyltransferase 2
A_64_P071485	1.59	<±1.00	RGD1563941	Rattus norvegicus similar to hypothetical protein FLJ20010 (RGD1563941), mRNA [NM_001109293]	chr8	similar to hypothetical protein FLJ20010
A_64_P066505	1.54	<±1.00	Esrp1	Rattus norvegicus epithelial splicing regulatory protein 1 (Esrp1), mRNA [NM_001127564]	chr5	epithelial splicing regulatory protein 1
A_64_P015618	1.54	<±1.00	Slc12a3	Rattus norvegicus solute carrier family 12 (sodium/chloride transporters), member 3 (Slc12a3), mRNA [NM_019345]	chr19	solute carrier family 12 (sodium/chloride transporters), member 3
A_64_P103596	1.52	<±1.00	Gpr152	PREDICTED: Rattus norvegicus G protein-coupled receptor 152 (Gpr152), mRNA [XM_002725764]	chr1	G protein-coupled receptor 152
A_64_P027625	1.50	<±1.00	Rxrg	Rattus norvegicus retinoid X receptor gamma (Rxrg), mRNA [NM_031765]	chr13	retinoid X receptor gamma
A_64_P031966	1.48	<±1.00	Adamts17	Uncharacterized protein [Source:UniProtKB/TrEMBL;Acc:D4ABB3] [ENSRNOT00000055877]	chr1	ADAM metallopeptidase with thrombospondin type 1 motif, 17
A_44_P1047364	1.48	<±1.00	RGD1566265	Rattus norvegicus similar to RIKEN cDNA 2610002M06 (RGD1566265), mRNA [NM_001134589]	chrX	similar to RIKEN cDNA 2610002M06
A_42_P625922	1.41	<±1.00	Drd2	Rattus norvegicus dopamine receptor D2 (Drd2), mRNA [NM_012547]	chr8	dopamine receptor D2
A_42_P738549	1.35	<±1.00	Napsa	Rattus norvegicus napsin A aspartic peptidase (Napsa), mRNA [NM_031670]	chr1	napsin A aspartic peptidase
A_64_P109919	1.31	<±1.00	Myh2	Rattus norvegicus myosin, heavy chain 2, skeletal muscle, adult (Myh2), mRNA [NM_001135157]	chr10	myosin, heavy chain 2, skeletal muscle, adult
A_64_P046353	1.27	<±1.00	Hs6st1	Rattus norvegicus heparan sulfate 6-O-sulfotransferase 1 (Hs6st1), mRNA [NM_001108210]	chr9	heparan sulfate 6-O-sulfotransferase 1
A_64_P246847	1.25	<±1.00	LOC683282	PREDICTED: Rattus norvegicus similar to developmental pluripotency-associated 2 (LOC683282), mRNA [XM_001065240]	chr11	similar to developmental pluripotency-associated 2

A_64_P014457	1.24	<±1.00	Zfp278	Rattus norvegicus zinc finger protein 278 (Zfp278), mRNA [NM_001107231]	chr14	zinc finger protein 278
A_64_P054621	1.17	<±1.00	Tmem164	transmembrane protein 164 [Source:RefSeq peptide;Acc:NP_001102484] [ENSRNOT00000005633]	chrX	transmembrane protein 164
A_64_P095670	1.15	<±1.00	Olr1688	Rattus norvegicus olfactory receptor 1688 (Olr1688), mRNA [NM_001000275]	chr20	olfactory receptor 1688
A_43_P22238	1.15	<±1.00	Naf1	Rattus norvegicus nuclear assembly factor 1 homolog (S. cerevisiae) (Naf1), mRNA [NM_001024772]	chr16	nuclear assembly factor 1 homolog (S. cerevisiae)
A_44_P128564	1.13	<±1.00	Stam	Rattus norvegicus signal transducing adaptor molecule (SH3 domain and ITAM motif) 1 (Stam), mRNA [NM_001109121]	chr17	signal transducing adaptor molecule (SH3 domain and ITAM motif) 1
A_64_P018482	1.13	<±1.00		C5AR_RABIT (Q9TUE1) C5a anaphylatoxin chemotactic receptor (C5a-R) (C5aR) (CD88 antigen) (Fragment), partial (7%) [TC623897]	chr11	C5a anaphylatoxin chemotactic receptor (C5a-R)
A_64_P137369	1.13	<±1.00	Myh13	PREDICTED: Rattus norvegicus myosin, heavy chain 13, skeletal muscle (Myh13), mRNA [XM_001078857]	chr10	myosin, heavy chain 13, skeletal muscle
A_64_P011610	1.12	<±1.00	Ftsjd1	Rattus norvegicus FtsJ methyltransferase domain containing 1 (Ftsjd1), mRNA [NM_001106186]	chr19	FtsJ methyltransferase domain containing 1
A_64_P127016	1.12	<±1.00	Zbtb39	Rattus norvegicus zinc finger and BTB domain containing 39 (Zbtb39), mRNA [NM_001130537]	chr7	zinc finger and BTB domain containing 39
		<±1.00				
A_64_P057717	1.11	<±1.00	Gan	Rattus norvegicus gigaxonin (Gan), mRNA [NM_001107434]	chr19	gigaxonin
A_43_P19799	1.11	<±1.00	RGD1563222	Rattus norvegicus similar to RIKEN cDNA A930018P22 (RGD1563222), mRNA [NM_001108585]	chr3	similar to RIKEN cDNA A930018P22
A_64_P085861	1.10	<±1.00	Rtbdn	Rattus norvegicus retbindin (Rtbdn), mRNA [NM_001107165]	chr19	retbindin
A_64_P036345	1.08	<±1.00	Zfp563	Rattus norvegicus zinc finger protein 563 (Zfp563), mRNA [NM_001134561]	chr7	zinc finger protein 563 homolog
A_64_P163698	1.06	<±1.00	RGD1564677	PREDICTED: Rattus norvegicus similar to transcription factor ONECUT2 (RGD1564677), partial mRNA [XM_002725360]	chr18	similar to transcription factor ONECUT2
A_64_P053084	1.05	<±1.00	Grifin	Rattus norvegicus galectin-related inter-fiber protein (Grifin), mRNA [NM_057187]	chr12	galectin-related inter-fiber protein
A_44_P416695	1.05	<±1.00	Krt15	Rattus norvegicus keratin 15 (Krt15), mRNA [NM_001004022]	chr10	keratin 15
A_64_P122297	1.05	<±1.00	LOC691141	Rattus norvegicus hypothetical protein LOC691141 (LOC691141), mRNA [NM_001109624]	chr8	hypothetical protein LOC691141
A_64_P074914	1.02	<±1.00	Prtn3	Rattus norvegicus proteinase 3 (Prtn3), mRNA [NM_001024264]	chr7	proteinase 3
A_44_P992367	1.02	<±1.00	Tulp2	Rattus norvegicus tubby-like protein 2 (Tulp2), mRNA [NM_001012168]	chr1	tubby like protein 2
A_44_P699502	1.02	<±1.00	LOC687105	Rattus norvegicus hypothetical protein LOC687105 (LOC687105), mRNA [NM_001127591]		hypothetical protein LOC687105
A_44_P776423	<±1.00	-1.00	Opalin	Rattus norvegicus oligodendrocytic myelin paranodal and inner loop protein (Opalin), mRNA [NM_001017386]	chr1	oligodendrocytic myelin paranodal and inner loop protein
A_44_P513511	<±1.00	-1.01	Ccdc135	Rattus norvegicus coiled-coil domain containing 135 (Ccdc135), mRNA [NM_001106169]	chr19	coiled-coil domain containing 135

A_43_P11558	<±1.00	-1.01	Apod	Rattus norvegicus apolipoprotein D (Apod), mRNA [NM_012777]	chr11 random	apolipoprotein D
A_44_P289637	<±1.00	-1.01	Slc4a1	Rattus norvegicus solute carrier family 4 (anion exchanger), member 1 (Slc4a1), mRNA [NM_012651]	chr10	solute carrier family 4 (anion exchanger), member 1
A_64_P091662	<±1.00	-1.02	RGD1306233	Rattus norvegicus similar to hypothetical protein MGC29761 (RGD1306233), mRNA [NM_001106564]	chr3	similar to hypothetical protein MGC29761
A_42_P540950	<±1.00	-1.02	Ier2	Rattus norvegicus immediate early response 2 (Ier2), mRNA [NM_001009541]	chr19	immediate early response 2
A_44_P314110	<±1.00	-1.02	Ermn	Rattus norvegicus ermin, ERM-like protein (Ermn), mRNA [NM_001008311]	chr3	ermin, ERM-like protein
A_64_P003749	<±1.00	-1.02	Pax4	Rattus norvegicus paired box 4 (Pax4), mRNA [NM_031799]	chr4	paired box 4
A_64_P110599	<±1.00	-1.02	Plekhf1	Rattus norvegicus pleckstrin homology domain containing, family F (with FYVE domain) member 1 (Plekhf1), mRNA [NM_001013148]	chr1	pleckstrin homology domain containing, family F (with FYVE domain) member 1
A_64_P129662	<±1.00	-1.03	Slitrk6	Rattus norvegicus SLIT and NTRK-like family, member 6 (Slitrk6), mRNA [NM_001106057]	chr15	SLIT and NTRK-like family, member 6
A_44_P260099	<±1.00	-1.04	Ppap2c	Rattus norvegicus phosphatidic acid phosphatase type 2c (Ppap2c), mRNA [NM_139252]	chr7	phosphatidic acid phosphatase type 2c
A_44_P201028	<±1.00	-1.04	Nfil3	Rattus norvegicus nuclear factor, interleukin 3 regulated (Nfil3), mRNA [NM_053727]	chr17	nuclear factor, interleukin 3 regulated
A_64_P132852	<±1.00	-1.04	Insc	Rattus norvegicus inscuteable homolog (Drosophila) (Insc), mRNA [NM_001106285]	chr1	inscuteable homolog (Drosophila)
A_64_P162743	<±1.00	-1.04	Dnajc28	Rattus norvegicus DnaJ (Hsp40) homolog, subfamily C, member 28 (Dnajc28), mRNA [NM_001014124]	chr11	DnaJ (Hsp40) homolog, subfamily C, member 28
A_43_P16403	<±1.00	-1.04	Clca1	Rattus norvegicus chloride channel accessory 1 (Clca1), mRNA [NM_001107449]	chr2	chloride channel accessory 1
A_64_P005383	<±1.00	-1.04	LOC685304	Rattus norvegicus hypothetical protein LOC685304 (LOC685304), mRNA [NM_001195612]	chr11	hypothetical protein LOC685304
A_64_P083878	<±1.00	-1.04	Smyd1	Rattus norvegicus SET and MYND domain containing 1 (Smyd1), mRNA [NM_001106595]	chr4	SET and MYND domain containing 1
A_42_P766909	<±1.00	-1.05	Ppp1r14a	Rattus norvegicus protein phosphatase 1, regulatory (inhibitor) subunit 14A (Ppp1r14a), mRNA [NM_130403]	chr1	protein phosphatase 1, regulatory (inhibitor) subunit 14A
A_42_P484738	<±1.00	-1.06	Ctgf	Rattus norvegicus connective tissue growth factor (Ctgf), mRNA [NM_022266]	chr1	connective tissue growth factor
A_64_P025248	<±1.00	-1.06		Rattus norvegicus similar to glutamine repeat protein 1 (LOC365129), mRNA [XM_344830]	chr1 random	similar to glutamine repeat protein 1
A_44_P320752	<±1.00	-1.06	Rasl11a	Rattus norvegicus RAS-like family 11 member A (Rasl11a), mRNA [NM_001002829]	chr12	RAS-like family 11 member A
A_44_P914022	<±1.00	-1.07	LOC689933	Rattus norvegicus hypothetical protein LOC689933 (LOC689933), mRNA [NM_001135253]	chr7	hypothetical protein LOC689933
A_43_P12283	<±1.00	-1.07	Mog	Rattus norvegicus myelin oligodendrocyte glycoprotein (Mog), mRNA [NM_022668]	chr20	myelin oligodendrocyte glycoprotein
A_44_P1016829	<±1.00	-1.07	Trib1	Rattus norvegicus tribbles homolog 1 (Drosophila) (Trib1), mRNA [NM_023985]	chr7	tribbles homolog 1 (Drosophila)
A_44_P424723	<±1.00	-1.07	Sik1	Serine/threonine-protein kinase SIK1 [Source:UniProtKB/Swiss-Prot;Acc:Q9R1U5]	chr20	Serine/threonine-protein kinase

				[ENSRNOT00000001579]		
A_43_P14040	<±1.00	-1.07	Sgk2	Rattus norvegicus serum/glucocorticoid regulated kinase 2 (Sgk2), mRNA [NM_134463]	chr3	serum/glucocorticoid regulated kinase 2
A_43_P15837	<±1.00	-1.07	Ntrk2	Rattus norvegicus neurotrophic tyrosine kinase, receptor, type 2 (Ntrk2), transcript variant 3, mRNA [NM_001163169]	chr17	neurotrophic tyrosine kinase, receptor, type 2
A_64_P006102	<±1.00	-1.08	Gjc2	Rattus norvegicus gap junction protein, gamma 2 (Gjc2), mRNA [NM_001100784]	chr10	gap junction protein, gamma 2
A_44_P135224	<±1.00	-1.08	Plk3	Rattus norvegicus polo-like kinase 3 (Plk3), mRNA [NM_022187]	chr5	polo-like kinase 3
A_44_P608167	<±1.00	-1.08	Tmem116	Rattus norvegicus transmembrane protein 116 (Tmem116), mRNA [NM_001159625]	chr12	transmembrane protein 116
A_44_P499226	<±1.00	-1.08	Zfp438	Rattus norvegicus zinc finger protein 438 (Zfp438), mRNA [NM_001107358]	chr17	zinc finger protein 438
A_64_P105122	<±1.00	-1.09	LOC689926	Rattus norvegicus hypothetical protein LOC689926 (LOC689926), mRNA [NM_001163002]	chr10	hypothetical protein LOC689926
A_44_P504133	<±1.00	-1.09	Agmo	Rattus norvegicus alkylglycerol monooxygenase (Agmo), mRNA [NM_001135899]	chr6	alkylglycerol monooxygenase
A_44_P431774	<±1.00	-1.09	Csrnp1	Rattus norvegicus cysteine-serine-rich nuclear protein 1 (Csrnp1), mRNA [NM_001108786]	chr8	cysteine-serine-rich nuclear protein 1
A_64_P080643	<±1.00	-1.09	Erbb3	Rattus norvegicus v-erb-b2 erythroblastic leukemia viral oncogene homolog 3 (avian) (Erbb3), mRNA [NM_017218]	chr7	v-erb-b2 erythroblastic leukemia viral oncogene homolog 3 (avian)
A_43_P11040	<±1.00	-1.10	Tppp3	Rattus norvegicus tubulin polymerization-promoting protein family member 3 (Tppp3), mRNA [NM_001009639]	chr19	tubulin polymerization-promoting protein family member 3
A_64_P182546	<±1.00	-1.10	Iqgap3	Rattus norvegicus IQ motif containing GTPase activating protein 3 (Iqgap3), mRNA [NM_001191709]	chr2	IQ motif containing GTPase activating protein 3
A_44_P167930	<±1.00	-1.10	Mobp	Rattus norvegicus myelin-associated oligodendrocyte basic protein (Mobp), mRNA [NM_012720]	chr8	myelin-associated oligodendrocyte basic protein
A_44_P837382	<±1.00	-1.10	Treml1	Rattus norvegicus triggering receptor expressed on myeloid cells-like 1 (Treml1), mRNA [NM_001192001]	chr9	triggering receptor expressed on myeloid cells-like 1
A_64_P111058	<±1.00	-1.11	Lilrb3l	Rattus norvegicus leukocyte immunoglobulin-like receptor, subfamily B (with TM and ITIM domains), member 3-like (Lilrb3l), mRNA [NM_001037357]	chr1	leukocyte immunoglobulin-like receptor, subfamily B (with TM and ITIM domains), member 3-like
A_64_P058107	<±1.00	-1.11	Enpp6	Rattus norvegicus ectonucleotide pyrophosphatase/phosphodiesterase 6 (Enpp6), mRNA [NM_001107311]	chr16	ectonucleotide pyrophosphatase/phosphodiesterase 6
A_43_P10089	<±1.00	-1.11	Slc45a3	Rattus norvegicus solute carrier family 45, member 3 (Slc45a3), mRNA [NM_001135868]	chr13	solute carrier family 45, member 3
A_44_P389132	<±1.00	-1.12	Rgs18	Rattus norvegicus regulator of G-protein signaling 18 (Rgs18), mRNA [NM_001047084]	chr13	regulator of G-protein signaling 18
A_44_P402980	<±1.00	-1.12	Nkx6-2	Rattus norvegicus NK6 homeobox 2 (Nkx6-2), mRNA [NM_001107558]	chr1	NK6 homeobox 2
A_44_P606502	<±1.00	-1.12	Fam83f	Rattus norvegicus family with sequence similarity 83, member F (Fam83f), mRNA [NM_001130502]	chr7	family with sequence similarity 83, member F
A_64_P145686	<±1.00	-1.12	C1qtnf9	Rattus norvegicus C1q and tumor necrosis factor related protein 9 (C1qtnf9), mRNA [NM_001191891]	chr15	C1q and tumor necrosis factor related protein 9
A_64_P048506	<±1.00	-1.13	S1pr5	Rattus norvegicus sphingosine-1-phosphate receptor 5 (S1pr5), mRNA [NM_021775]	chr8	sphingosine-1-phosphate receptor 5

A_43_P16988	<±1.00	-1.14	Fa2h	Rattus norvegicus fatty acid 2-hydroxylase (Fa2h), mRNA [NM_001135583]	chr19	fatty acid 2-hydroxylase
A_44_P291728	<±1.00	-1.14	Ttn	PREDICTED: Rattus norvegicus titin (Ttn), mRNA [XM_001065955]	chr3	titin
A_44_P838490	<±1.00	-1.14	Rgr	Rattus norvegicus retinal G protein coupled receptor (Rgr), mRNA [NM_001107299]	chr16	retinal G protein coupled receptor
A_64_P152427	<±1.00	-1.14	Diaph2	PREDICTED: Rattus norvegicus diaphanous homolog 2 (Drosophila) (Diaph2), mRNA [XM_001066898]	chrX	diaphanous homolog 2 (Drosophila)
A_64_P157171	<±1.00	-1.14	LOC685249	PREDICTED: Rattus norvegicus hypothetical protein LOC685249 (LOC685249), mRNA [XM_001063008]	chr17	hypothetical protein LOC685249
A_64_P018756	<±1.00	-1.15	Cyp11a1	Rattus norvegicus cytochrome P450, family 11, subfamily a, polypeptide 1 (Cyp11a1), nuclear gene encoding mitochondrial protein, mRNA [NM_017286]	chr8	cytochrome P450, family 11, subfamily a, polypeptide 1
A_64_P029945	<±1.00	-1.15	Pign	Rattus norvegicus phosphatidylinositol glycan, class N (Pign), mRNA [NM_001100584]	chr13	phosphatidylinositol glycan, class N
A_44_P995694	<±1.00	-1.16	Lrrc36	Rattus norvegicus leucine rich repeat containing 36 (Lrrc36), mRNA [NM_001004088]	chr19	leucine rich repeat containing 36
A_64_P059485	<±1.00	-1.16	Ddit4	Rattus norvegicus DNA-damage-inducible transcript 4 (Ddit4), mRNA [NM_080906]	chr20	DNA-damage-inducible transcript 4
A_44_P520159	<±1.00	-1.16	P2ry2	Rattus norvegicus purinergic receptor P2Y, G-protein coupled, 2 (P2ry2), mRNA [NM_017255]	chr1	purinergic receptor P2Y, G-protein coupled, 2
A_64_P067233	<±1.00	-1.16	Gpt2	Rattus norvegicus Cc2-5 mRNA, complete cds. [AY325245]	chr19	Cc2-5
A_64_P043259	<±1.00	-1.17	P2rx6	Rattus norvegicus purinergic receptor P2X, ligand-gated ion channel, 6 (P2rx6), mRNA [NM_012721]	chr11	purinergic receptor P2X, ligand-gated ion channel, 6
A_43_P12924	<±1.00	-1.17	Abcg5	Rattus norvegicus ATP-binding cassette, subfamily G (WHITE), member 5 (Abcg5), mRNA [NM_053754]	chr6	ATP-binding cassette, subfamily G (WHITE), member
A_64_P002756	<±1.00	-1.17	RGD1359349	Rattus norvegicus similar to hypothetical protein MGC34760 (RGD1359349), mRNA [NM_001007738]	chr1	similar to hypothetical protein MGC34760
A_64_P106356	<±1.00	-1.18	Ccdc153	Rattus norvegicus coiled-coil domain containing 153 (Ccdc153), mRNA [NM_001013953]	chr8	coiled-coil domain containing 153
A_64_P009803	<±1.00	-1.18	Btg2	Rattus norvegicus BTG family, member 2 (Btg2), mRNA [NM_017259]	chr13	BTG family, member 2
A_64_P088650	<±1.00	-1.19	Ncam2	neural cell adhesion molecule 2 [Source:RefSeq peptide;Acc:NP_981954] [ENSRNOT00000031017]	chr11	neural cell adhesion molecule 2
A_44_P536275	<±1.00	-1.19	Adamts4	Rattus norvegicus ADAM metallopeptidase with thrombospondin type 1 motif, 4 (Adamts4), mRNA [NM_023959]	chr13	ADAM metallopeptidase with thrombospondin type 1 motif, 4
A_43_P12808	<±1.00	-1.20	Cldn11	Rattus norvegicus claudin 11 (Cldn11), mRNA [NM_053457]	chr2	claudin 11
A_44_P186962	<±1.00	-1.20	Olr403	Rattus norvegicus olfactory receptor 403 (Olr403), mRNA [NM_001000381]	chr3	olfactory receptor 403
A_64_P110284	<±1.00	-1.20	Tbc1d10c	Rattus norvegicus TBC1 domain family, member 10C (Tbc1d10c), mRNA [NM_001081980]	chr1	TBC1 domain family, member 10C
A_64_P071332	<±1.00	-1.21	Plp1	Rattus norvegicus proteolipid protein 1 (Plp1), mRNA [NM_030990]	chrX	proteolipid protein 1
A_42_P762829	<±1.00	-1.21	Cebpd	Rattus norvegicus CCAAT/enhancer binding protein (C/EBP), delta (Cebpd),		CCAAT/enhancer binding protein (C/EBP), delta

				mRNA [NM_013154]		
A_44_P556989	<±1.00	-1.23	Ngfr	Rattus norvegicus nerve growth factor receptor (TNFR superfamily, member 16) (Ngfr), mRNA [NM_012610]	chr10	nerve growth factor receptor (TNFR superfamily, member 16)
A_44_P395654	<±1.00	-1.24	Olr1516	Rattus norvegicus olfactory receptor 1516 (Olr1516), mRNA [NM_001000038]	chr10	olfactory receptor 1516
A_64_P159468	<±1.00	-1.24	Pmp2	Rattus norvegicus peripheral myelin protein 2 (Pmp2), mRNA [NM_001109514]	chr2	peripheral myelin protein 2
A_44_P147055	<±1.00	-1.25	Gjb1	Rattus norvegicus gap junction protein, beta 1 (Gjb1), mRNA [NM_017251]	chrX	gap junction protein, beta 1
A_42_P544898	<±1.00	-1.25	Bcl6b	Rattus norvegicus B-cell CLL/lymphoma 6, member B (Bcl6b), mRNA [NM_001108279]	chr10	B-cell CLL/lymphoma 6, member B
A_43_P13226	<±1.00	-1.26	Slc31a1	Rattus norvegicus solute carrier family 31 (copper transporters), member 1 (Slc31a1), mRNA [NM_133600]	chr5	solute carrier family 31 (copper transporters), member 1
A_64_P139173	<±1.00	-1.27	Cd40	Rattus norvegicus CD40 molecule, TNF receptor superfamily member 5 (Cd40), mRNA [NM_134360]	chr3	CD40 molecule, TNF receptor superfamily member 5
A_64_P144869	<±1.00	-1.27	Casq2	Rattus norvegicus calsequestrin 2 (cardiac muscle) (Casq2), nuclear gene encoding mitochondrial protein, mRNA [NM_017131]	chr2	calsequestrin 2 (cardiac muscle)
A_42_P738431	<±1.00	-1.27	Klk6	Rattus norvegicus kallikrein related-peptidase 6 (Klk6), mRNA [NM_019175]	chr1	kallikrein related-peptidase 6
A_44_P212953	<±1.00	-1.28	Tdrd5	Rattus norvegicus tudor domain containing 5 (Tdrd5), transcript variant 2, mRNA [NM_001134740]	chr13	tudor domain containing 5
A_64_P119472	<±1.00	-1.29	Olr1108	Rattus norvegicus olfactory receptor 1108 (Olr1108), mRNA [NM_001000993]	chr7	olfactory receptor 1108
A_64_P108215	<±1.00	-1.31	RGD1564496	PREDICTED: Rattus norvegicus RGD1564496 (RGD1564496), mRNA [XM_001073145]	chr2	RGD1564496
A_44_P814538	<±1.00	-1.32	Uba6	Rattus norvegicus ubiquitin-like modifier activating enzyme 6 (Uba6), mRNA [NM_001107213]	chr14	ubiquitin-like modifier activating enzyme 6
A_42_P771201	<±1.00	-1.33	Nhlh1	Rattus norvegicus nescient helix loop helix 1 (Nhlh1), mRNA [NM_001105970]	chr13	nescient helix loop helix 1
A_44_P433614	<±1.00	-1.33	Best1	Rattus norvegicus bestrophin 1 (Best1), mRNA [NM_001011940]	chr1	bestrophin 1
A_64_P147674	<±1.00	-1.34	Sik1	Rattus norvegicus salt-inducible kinase 1 (Sik1), mRNA [NM_021693]	chr20	salt-inducible kinase 1
A_43_P12228	<±1.00	-1.35	Rhd	Rattus norvegicus Rh blood group, D antigen (Rhd), mRNA [NM_022505]	chr5	Rh blood group, D antigen
A_44_P472661	<±1.00	-1.35	Klf2	Rattus norvegicus Kruppel-like factor 2 (lung) (Klf2), mRNA [NM_001007684]	chr16	Kruppel-like factor 2 (lung)
A_43_P19822	<±1.00	-1.35	Rsph10b	Rattus norvegicus radial spoke head 10 homolog B (Chlamydomonas) (Rsph10b), mRNA [NM_001013867]	chr12	radial spoke head 10 homolog B (Chlamydomonas)
A_42_P682589	<±1.00	-1.39	Nr4a1	Rattus norvegicus nuclear receptor subfamily 4, group A, member 1 (Nr4a1), mRNA [NM_024388]	chr7	nuclear receptor subfamily 4, group A, member 1
A_64_P152671	<±1.00	-1.39		Rattus norvegicus similar to putative pheromone receptor (LOC301894), mRNA [XM_229376]	chrUn random	similar to putative pheromone receptor
A_64_P135996	<±1.00	-1.40	Tmem88b	Rattus norvegicus transmembrane protein 88B (Tmem88b), mRNA [NM_001109426]	chr5	transmembrane protein 88B
A_43_P12908	<±1.00	-1.42	Klf4	Rattus norvegicus Kruppel-like factor 4 (gut) (Klf4), mRNA [NM_053713]	chr5	Kruppel-like factor 4 (gut)
A_64_P024772	<±1.00	-1.42		Ig gamma-2B chain C region [Source:UniProtKB/Swiss-Prot;Acc:P20761]	chr6	Ig gamma-2B chain C region

				[ENSRNOT00000007140]		
A_64_P058871	<±1.00	-1.44	Tnnt1	Rattus norvegicus troponin T type 1 (skeletal, slow) (Tnnt1), mRNA [NM_134388]	chr1	troponin T type 1 (skeletal, slow)
A_64_P127589	<±1.00	-1.46		Q5U2T7_RAT (Q5U2T7) Transcription factor B2, mitochondrial (Predicted), partial (21%) [TC645744]	chr13	Transcription factor B2, mitochondrial (Predicted)
A_64_P021443	<±1.00	-1.47	RGD1560672	Rattus norvegicus similar to novel protein (RGD1560672), mRNA [NM_001109073]	chr13	similar to novel protein
A_64_P131051	<±1.00	-1.48	Fos	Rattus norvegicus FBJ osteosarcoma oncogene (Fos), mRNA [NM_022197]	chr6	FBJ osteosarcoma oncogene
A_44_P448154	<±1.00	-1.49	Cyp2j10	Rattus norvegicus cytochrome P450, family 2, subfamily j, polypeptide 10 (Cyp2j10), mRNA [NM_001134980]	chr5	cytochrome P450, family 2, subfamily j, polypeptide 10
A_64_P043140	<±1.00	-1.50	LOC691277	Rattus norvegicus similar to Robo-1 (LOC691277), mRNA [NM_001109633]	chr10	similar to Robo-1
A_64_P001956	<±1.00	-1.51	RGD1565859	PREDICTED: Rattus norvegicus RGD1565859 (RGD1565859), mRNA [XM_001063482]	chr1	RGD1565859
A_44_P1037285	<±1.00	-1.52	Slc44a4	Rattus norvegicus solute carrier family 44, member 4 (Slc44a4), mRNA [NM_212541]	chr20	solute carrier family 44, member 4
A_64_P045516	<±1.00	-1.52	LOC685577	PREDICTED: Rattus norvegicus similar to major urinary protein 5 (LOC685577), miscRNA [XR_006055]	chr5	similar to major urinary protein 5
A_64_P029805	<±1.00	-1.53	Junb	Rattus norvegicus jun B proto-oncogene (Junb), mRNA [NM_021836]	chr19	jun B proto-oncogene
A_44_P118724	<±1.00	-1.56	Arc	Rattus norvegicus activity-regulated cytoskeleton-associated protein (Arc), mRNA [NM_019361]	chr7	activity-regulated cytoskeleton-associated protein
A_44_P457599	<±1.00	-1.56	Foxj1	Rattus norvegicus forkhead box J1 (Foxj1), mRNA [NM_053832]		forkhead box J1
A_64_P065235	<±1.00	-1.56	Clrn1	Rattus norvegicus clarin 1 (Clrn1), mRNA [NM_153299]	chr2	clarin 1
A_64_P303373	<±1.00	-1.58	Gdf5	PREDICTED: Rattus norvegicus growth differentiation factor 5 (Gdf5), mRNA [XM_001066344]		growth differentiation factor 5
A_64_P147106	<±1.00	-1.60	B3gnt6	Rattus norvegicus UDP-GlcNAc:betaGal beta-1,3-N-acetylglucosaminyltransferase 6 (core 3 synthase) (B3gnt6), mRNA [NM_001106211]	chr1	UDP-GlcNAc:betaGal beta-1,3-N-acetylglucosaminyltransferase 6 (core 3 synthase)
A_64_P053061	<±1.00	-1.61		Rattus norvegicus similar to glutamine repeat protein 1 (LOC365129), mRNA [XM_344830]	chr1	similar to glutamine repeat protein 1
A_43_P12927	<±1.00	-1.66	Dusp1	Rattus norvegicus dual specificity phosphatase 1 (Dusp1), mRNA [NM_053769]	chr10	dual specificity phosphatase 1
A_64_P007929	<±1.00	-1.66	Bucs1	Rattus norvegicus butyryl Coenzyme A synthetase 1 (Bucs1), mRNA [NM_001108502]	chr1	butyryl Coenzyme A synthetase 1
A_64_P033994	<±1.00	-1.68	Pax9	Rattus norvegicus paired box 9 (Pax9), mRNA [NM_001039539]	chr6	paired box 9
A_44_P445044	<±1.00	-1.72	Apold1	Rattus norvegicus apolipoprotein L domain containing 1 (Apold1), mRNA [NM_001003403]	chr4	apolipoprotein L domain containing 1
A_64_P158384	<±1.00	-1.73	RGD1359452	Rattus norvegicus similar to hypothetical protein FLJ32800 (RGD1359452), mRNA [NM_001013920]	chr3	similar to hypothetical protein FLJ32800
A_64_P027752	<±1.00	-1.77	Lrrc34	Rattus norvegicus leucine rich repeat containing 34 (Lrrc34), mRNA [NM_001044696]	chr2	leucine rich repeat containing 34
A_64_P113069	<±1.00	-1.77	RGD1559683	Rattus norvegicus similar to RIKEN cDNA 1700001C02 (RGD1559683), mRNA [NM_001109275]	chr6	similar to RIKEN cDNA 1700001C02

A_44_P575255	<±1.00	-1.82	RGD1562658	Rattus norvegicus similar to RIKEN cDNA 1700009P17 (RGD1562658), mRNA [NM_001109075]	chr13	similar to RIKEN cDNA 1700009P17
A_64_P055972	<±1.00	-1.83	Kcnk16	Rattus norvegicus potassium channel, subfamily K, member 16 (Kcnk16), mRNA [NM_001109520]	chr15	potassium channel, subfamily K, member 16
A_64_P026157	<±1.00	-1.85	LOC689749	PREDICTED: Rattus norvegicus similar to apoptotic chromatin condensation inducer 1 isoform 2 (LOC689749), mRNA [XM_001071871]	chr7	similar to apoptotic chromatin condensation inducer 1 isoform 2
A_44_P154793	<±1.00	-1.85	Iqcg	Rattus norvegicus IQ motif containing G (Iqcg), mRNA [NM_001014230]	chr11	IQ motif containing G
A_44_P965869	<±1.00	-1.86	Arid3b	Rattus norvegicus AT rich interactive domain 3B (Bright like) (Arid3b), mRNA [NM_001109001]	chr8	AT rich interactive domain 3B (Bright like)
A_64_P061504	<±1.00	-1.86	Ccdc40	Rattus norvegicus coiled-coil domain containing 40 (Ccdc40), mRNA [NM_001134688]	chrUn	coiled-coil domain containing 40
A_64_P079326	<±1.00	-1.87	Tp73	Rattus norvegicus tumor protein p73 (Tp73), mRNA [NM_001108696]	chr5	tumor protein p73
A_64_P066326	<±1.00	-1.92	LOC682377	PREDICTED: Rattus norvegicus similar to olfactory receptor 697 (LOC682377), partial mRNA [XM_001061252]		similar to olfactory receptor 697
A_44_P222404	<±1.00	-1.94	RGD1310371	Rattus norvegicus similar to RIKEN cDNA 1700026D08 (RGD1310371), mRNA [NM_001100581]	chr1	similar to RIKEN cDNA 1700026D08
A_43_P16203	<±1.00	-1.96	Asb14	Ankyrin repeat and SOCS box protein 14 [Source:UniProtKB/Swiss-Prot;Acc:P0C927] [ENSRNOT00000017847]	chr16	Ankyrin repeat and SOCS box protein 14
A_64_P020711	<±1.00	-1.99	Dynlrb2	Rattus norvegicus dynein light chain roadblock-type 2 (Dynlrb2), mRNA [NM_001108451]	chr19	dynein light chain roadblock-type 2
A_64_P078852	<±1.00	-2.00	RGD1560151	PREDICTED: Rattus norvegicus similar to predicted CDS, mechanosensory transduction channel NOMPC (1O503) (RGD1560151), mRNA [XM_576520]	chr9	similar to predicted CDS, mechanosensory transduction channel NOMPC (1O503)
A_64_P034572	<±1.00	-2.02	Slc16a5	Rattus norvegicus solute carrier family 16, member 5 (monocarboxylic acid transporter 6) (Slc16a5), mRNA [NM_001109568]	chr10	solute carrier family 16, member 5 (monocarboxylic acid transporter 6)
A_64_P005288	<±1.00	-2.05	Wdr38	PREDICTED: Rattus norvegicus WD repeat domain 38 (Wdr38), mRNA [XM_575125]	chr3	WD repeat domain 38
A_44_P899127	<±1.00	-2.07	LOC500300	Rattus norvegicus similar to hypothetical protein MGC6835 (LOC500300), mRNA [NM_001024334]	chr4	similar to hypothetical protein MGC6835
A_44_P342739	<±1.00	-2.07	Ribc2	Rattus norvegicus RIB43A domain with coiled-coils 2 (Ribc2), mRNA [NM_001013949]	chr7	RIB43A domain with coiled-coils 2
A_64_P014627	<±1.00	-2.09	LOC690276	Rattus norvegicus hypothetical protein LOC690276 (LOC690276), mRNA [NM_001109573]	chr6	hypothetical protein LOC690276
A_64_P107892	<±1.00	-2.10	Folr1	Rattus norvegicus folate receptor 1 (adult) (Folr1), mRNA [NM_133527]	chr1	folate receptor 1 (adult)
A_64_P075357	<±1.00	-2.11	Cyr61	Rattus norvegicus cysteine-rich, angiogenic inducer, 61 (Cyr61), mRNA [NM_031327]	chr2	cysteine-rich, angiogenic inducer, 61
A_44_P424218	<±1.00	-2.12	Mlf1	Rattus norvegicus myeloid leukemia factor 1 (Mlf1), mRNA [NM_001107680]	chr2	myeloid leukemia factor 1
A_64_P071913	<±1.00	-2.15	Nsun4	Rattus norvegicus NOP2/Sun domain family, member 4 (Nsun4), mRNA [NM_001106678]	chr5	NOP2/Sun domain family, member 4
A_64_P100495	<±1.00	-2.21	Slc10a4	Rattus norvegicus solute carrier family 10 (sodium/bile acid cotransporter family),	chr14	solute carrier family 10 (sodium/bile acid

				member 4 (Slc10a4), mRNA [NM_001008555]		cotransporter family), member 4
A_44_P1025667	<±1.00	-2.23	Ccdc37	Coiled-coil domain containing 37 (Predicted), isoform CRA_cUncharacterized protein [Source:UniProtKB/TrEMBL;Acc:D3ZEI2] [ENSRNOT00000024222]	chr4	Coiled-coil domain containing 37 (Predicted)
A_64_P098735	<±1.00	-2.26	Calml4	Rattus norvegicus calmodulin-like 4 (Calml4), mRNA [NM_001127575]	chr8	calmodulin-like 4
A_44_P251008	<±1.00	-2.27	Efhb	Rattus norvegicus EF hand domain family, member B (Efhb), mRNA [NM_001106879]	chr9	EF hand domain family, member B
A_64_P150326	<±1.00	-2.30	LOC100360315	PREDICTED: Rattus norvegicus spermatogenesis associated glutamate (E)-rich protein 4e-like (LOC100360315), mRNA [XM_002730116]	chrUn	spermatogenesis associated glutamate (E)-rich protein 4e-like
A_64_P013837	<±1.00	-2.31	RGD1310641	Rattus norvegicus similar to hypothetical protein (RGD1310641), mRNA [NM_001079701]	chr5	similar to hypothetical protein
A_64_P094910	<±1.00	-2.31	Spag6	Rattus norvegicus sperm associated antigen 6 (Spag6), mRNA [NM_001034960]	chr11	sperm associated antigen 6
A_44_P492173	<±1.00	-2.34	Capsl	Rattus norvegicus calcyphosine-like (Capsl), mRNA [NM_001106417]	chr2	calcyphosine-like
A_64_P087596	<±1.00	-2.45	LOC688570	PREDICTED: Rattus norvegicus similar to butyrate-induced transcript 1 (LOC688570), mRNA [XM_001067468]	chrX	similar to butyrate-induced transcript 1
A_64_P063554	<±1.00	-2.45	Atp7a	Copper-transporting ATPase 1 [Source:UniProtKB/Swiss-Prot;Acc:P70705] [ENSRNOT00000003395]	chrX	Copper-transporting ATPase 1
A_64_P057196	<±1.00	-2.47	Cldn14	Rattus norvegicus claudin 14 (Cldn14), mRNA [NM_001013429]	chr11	claudin 14
A_64_P060614	<±1.00	-2.49	T2	Rattus norvegicus brachyury 2 (T2), mRNA [NM_001161835]	chr1	brachyury 2
A_64_P127576	<±1.00	-2.53	Mpz	Rattus norvegicus myelin protein zero (Mpz), mRNA [NM_017027]	chr13	myelin protein zero
A_64_P105373	<±1.00	-2.60	RGD1561795	Rattus norvegicus similar to RIKEN cDNA 1700012B09 (RGD1561795), mRNA [NM_001109289]	chr8	similar to RIKEN cDNA 1700012B09
A_64_P160550	<±1.00	-2.65	Gpr171	Rattus norvegicus G protein-coupled receptor 171 (Gpr171), mRNA [NM_001109510]	chr2	G protein-coupled receptor 171
A_64_P051510	<±1.00	-2.70	LOC687303	PREDICTED: Rattus norvegicus similar to F35C5.3 (LOC687303), mRNA [XM_001077913]	chr19	similar to F35C5.3
A_64_P083049	<±1.00	-2.71		CR473051 Rat pBluescript Lion Rattus norvegicus cDNA clone LIONp463G031453', mRNA sequence [CR473051]	chrUn random	cDNA clone LIONp463G03145 3'
A_42_P795467	<±1.00	-2.75	Ak7	Rattus norvegicus adenylate kinase 7 (Ak7), mRNA [NM_001108055]	chr6	adenylate kinase 7
A_64_P002299	<±1.00	-2.96	Olr1239	Rattus norvegicus olfactory receptor 1239 (Olr1239), mRNA [NM_001000811]	chr8	olfactory receptor 1239
A_64_P162178	<±1.00	-2.97	Slc5a8	Rattus norvegicus solute carrier family 5 (iodide transporter), member 8 (Slc5a8), mRNA [NM_001191987]	chr7	solute carrier family 5 (iodide transporter), member 8
A_64_P036153	<±1.00	-3.06	Olr1318	Rattus norvegicus olfactory receptor 1318 (Olr1318), mRNA [NM_001001087]	chr8	olfactory receptor 1318
A_64_P099710	<±1.00	-3.07	Wfdc5	Rattus norvegicus WAP four-disulfide core domain 5 (Wfdc5), mRNA [NM_001106538]	chr3	WAP four-disulfide core domain 5
A_64_P125023	<±1.00	-3.08	RGD1561693	PREDICTED: Rattus norvegicus similar to Gene model 784 (RGD1561693), miscRNA [XR_085950]	chrX	similar to Gene model 784

A_64_P004869	<±1.00	-3.18	Taar7h	Rattus norvegicus trace amine-associated receptor 7h (Taar7h), mRNA [NM_175587]	chr1	trace amine-associated receptor 7h
A_43_P11616	<±1.00	-3.27	Atf3	Rattus norvegicus activating transcription factor 3 (Atf3), mRNA [NM_012912]	chr13	activating transcription factor 3
A_44_P533786	<±1.00	-3.31	Aurkb	Rattus norvegicus aurora kinase B (Aurkb), mRNA [NM_053749]	chr10	aurora kinase B
A_42_P598679	<±1.00	-3.40	Ano1	Rattus norvegicus anoctamin 1, calcium activated chloride channel (Ano1), mRNA [NM_001107564]	chr1	anoctamin 1, calcium activated chloride channel
A_64_P037373	<±1.00	-3.52	LOC100360108	PREDICTED: Rattus norvegicus cell surface receptor FDFACT-like (LOC100360108), mRNA [XM_002727949]	chr12	cell surface receptor FDFACT-like
A_64_P054692	<±1.00	-3.57	Tmem212	Rattus norvegicus transmembrane protein 212 (Tmem212), transcript variant 2, mRNA [NM_001164439]	chr2	transmembrane protein 212
A_64_P113592	<±1.00	-3.58	Fam25a	Rattus norvegicus family with sequence similarity 25, member A (Fam25a), mRNA [NM_001134849]	chr16	family with sequence similarity 25, member A
A_64_P164784	<±1.00	-3.87	Sec31b	Rattus norvegicus SEC31 homolog B (S. cerevisiae) (Sec31b), mRNA [NM_001135713]	chr1	SEC31 homolog B (S. cerevisiae)
A_44_P977085	<±1.00	-3.96	LOC680885	Rattus norvegicus hypothetical protein LOC680885 (LOC680885), mRNA [NM_001109431]	chr16	hypothetical protein LOC680885
A_44_P913381	<±1.00	-4.30	RGD1565611	Rattus norvegicus RGD1565611 (RGD1565611), mRNA [NM_001110155]	chr10	RGD1565611
A_64_P138365	<±1.00	-4.41		Cytochrome P450 4A2 [Source:UniProtKB/Swiss-Prot;Acc:P20816] [ENSRNOT00000051252]	chr5	Cytochrome P450 4A2
A_44_P449858	<±1.00	-4.68	Krt20	Rattus norvegicus keratin 20 (Krt20), mRNA [NM_173128]	chr10	keratin 20
A_64_P010523	<±1.00	-4.71	Ecg2	Rattus norvegicus esophagus cancer-related protein 2 (Ecg2), mRNA [NM_001002816]	chr18	esophagus cancer-related protein 2
A_64_P105383	<±1.00	-5.70	Myh2	Rattus norvegicus myosin, heavy chain 2, skeletal muscle, adult (Myh2), mRNA [NM_001135157]	chr10	myosin, heavy chain 2, skeletal muscle, adult
A_43_P15663	-2.07	1.60	Eln	Rattus norvegicus elastin (Eln), mRNA [NM_012722]	chr12	elastin
A_42_P599116	-1.63	1.02	Phldb3	Rattus norvegicus pleckstrin homology-like domain, family B, member 3 (Phldb3), mRNA [NM_001191622]	chr1	pleckstrin homology-like domain, family B, member 3
A_64_P038639	-1.60	1.37	LOC679835	FM119812 etnohea Rattus norvegicus cDNA clone etnoheaP0047K24 3', mRNA sequence [FM119812]	chr4	similar to Anionic trypsin II precursor (Pretrypsinogen II)
A_42_P798447	-1.48	1.43	LOC687797	PREDICTED: Rattus norvegicus similar to tumor suppressor candidate 5 (LOC687797), mRNA [XM_001080179]	chr12	similar to tumor suppressor candidate 5
A_64_P003234	-1.37	1.57	Asb16	Rattus norvegicus ankyrin repeat and SOCS box-containing 16 (Asb16), mRNA [NM_001109048]	chr10	ankyrin repeat and SOCS box-containing 16
A_64_P124075	-1.31	2.13	RGD1311659	Rattus norvegicus similar to Proteasome subunit alpha type 7-like (RGD1311659), mRNA [NM_001108884]	chr18	similar to Proteasome subunit alpha type 7-like
A_64_P001426	-1.25	2.07	LOC688276	Rattus norvegicus similar to epidermodysplasia verruciformis 2 (LOC688276), mRNA [NM_001126301]		similar to epidermodysplasia verruciformis 2
A_44_P186914	-1.25	1.06	Ggt5	Rattus norvegicus gamma-glutamyltransferase 5 (Ggt5), mRNA [NM_019235]		gamma-glutamyltransferase 5
A_64_P142251	-1.11	1.46	Chia	Rattus norvegicus chitinase, acidic (Chia), mRNA [NM_207586]	chr2	chitinase, acidic

A_44_P252728	-1.04	1.33	LOC100366258	Uncharacterized protein [Source:UniProtKB/TrEMBL;Acc:D3ZL26] [ENSRNOT00000051182]	chr15	rCG38397-like
A_44_P455101	-1.02	1.85	RGD1561102	Rattus norvegicus similar to ribosomal protein S12 (RGD1561102), mRNA [NM_001106777]	chr7	similar to ribosomal protein S12
A_43_P11086	-1.02	1.16	Upk1b	Rattus norvegicus uroplakin 1B (Upk1b), mRNA [NM_001024253]	chr11	uroplakin 1B
A_64_P028513	-1.01	<±1.00	LOC689337	PREDICTED: Rattus norvegicus similar to within bgcn homolog (LOC689337), miscRNA [XR_006618]	chrUn	similar to within bgcn homolog
A_64_P017560	-1.03	<±1.00	Eddm3b	Rattus norvegicus epididymal protein 3B (Eddm3b), mRNA [NM_178103]	chr15	epididymal protein 3B
A_64_P007163	-1.03	<±1.00	Mybphl	Rattus norvegicus myosin binding protein H-like (Mybphl), mRNA [NM_001014042]	chr2	myosin binding protein H-like
A_64_P011419	-1.03	<±1.00	Cdon	Rattus norvegicus Cdon homolog (mouse) (Cdon), mRNA [NM_017358]	chr8	Cdon homolog (mouse)
A_44_P447601	-1.04	<±1.00	RGD1359156	Rattus norvegicus similar to hypothetical protein FLJ25414 (RGD1359156), mRNA [NM_001005531]	chr10	similar to hypothetical protein FLJ25414
A_44_P212813	-1.04	<±1.00	Acsm5	Rattus norvegicus acyl-CoA synthetase medium-chain family member 5 (Acsm5), mRNA [NM_001014162]	chr1	acyl-CoA synthetase medium-chain family member 5
A_43_P12529	-1.05	<±1.00	Stxbp2	Rattus norvegicus syntaxin binding protein 2 (Stxbp2), mRNA [NM_031126]	chr12	syntaxin binding protein 2
A_64_P094821	-1.07	<±1.00	Gtf3c4	Rattus norvegicus general transcription factor IIIC, polypeptide 4 (Gtf3c4), mRNA [NM_001109473]	chr3	general transcription factor IIIC, polypeptide 4
A_64_P018297	-1.07	<±1.00	LOC679219	PREDICTED: Rattus norvegicus similar to extraembryonic, spermatogenesis, homeobox 1 (LOC679219), mRNA [XM_001055261]		similar to extraembryonic, spermatogenesis, homeobox 1
A_64_P035808	-1.07	<±1.00	Ms4a8a	Rattus norvegicus membrane-spanning 4-domains, subfamily A, member 8A (Ms4a8a), mRNA [NM_001108519]	chr1	membrane-spanning 4-domains, subfamily A, member 8A
A_64_P142871	-1.08	<±1.00		RCG43176RGD1559811 protein [Source:UniProtKB/TrEMBL;Acc:B5DFG0] [ENSRNOT00000018362]	chr16	RCG43176RGD1559811
A_64_P209731	-1.08	<±1.00	Tet3	Uncharacterized protein [Source:UniProtKB/TrEMBL;Acc:D3ZES0] [ENSRNOT00000031521]	chr4	tet methylcytosine dioxygenase 3
A_64_P012036	-1.09	<±1.00	Vom2r48	Rattus norvegicus vomeronasal 2 receptor, 48 (Vom2r48), mRNA [NM_001099514]	chr4	vomeronasal 2 receptor, 48
A_43_P13334	-1.10	<±1.00	Slc22a25	Rattus norvegicus solute carrier family 22, member 25 (Slc22a25), mRNA [NM_138908]	chr1	solute carrier family 22, member 25
A_43_P19494	-1.10	<±1.00	LOC688972	PREDICTED: Rattus norvegicus similar to Glycophorin (LOC688972), mRNA [XM_001069014]	chr19	similar to Glycophorin
A_64_P123675	-1.11	<±1.00		AE001111 A. fulgidus predicted coding region AF2391 {Archaeoglobus fulgidus DSM 4304} (exp=-1; wgp=0; cg=1), partial (26%) [TC624087]	chr12	AE001111 A. fulgidus predicted coding region AF2391
A_64_P017585	-1.12	<±1.00	LOC100363531	Rattus norvegicus LRRGT00182-like (LOC100363531), mRNA [NM_001177826]	chrX	LRRGT00182-like
A_64_P112165	-1.15	<±1.00		PREDICTED: Rattus norvegicus similar to H3 histone, family 3B (LOC685984), mRNA [XM_001066068]	chr4	similar to H3 histone, family 3B
A_44_P372640	-1.16	<±1.00	Catsperg1	Rattus norvegicus cation channel, sperm-associated, gamma 1 (Catsperg1), mRNA [NM_001170340]	chr1	cation channel, sperm-associated, gamma 1

A_44_P785821	-1.16	<±1.00	RGD1560775	RGD1560775 protein [Source:UniProtKB/TrEMBL;Acc:A1A5Q3] [ENSRNOT00000067996]	chr8	RGD1560775 protein
A_44_P449938	-1.17	<±1.00	Kcnj13	Rattus norvegicus potassium inwardly-rectifying channel, subfamily J, member 13 (Kcnj13), mRNA [NM_053608]	chr9	potassium inwardly-rectifying channel, subfamily J, member 13
A_44_P128079	-1.17	<±1.00	Olr1557	Rattus norvegicus olfactory receptor 1557 (Olr1557), mRNA [NM_001000050]	chr11	olfactory receptor 1557
A_64_P125235	-1.17	<±1.00	Pkhd1l1	Rattus norvegicus polycystic kidney and hepatic disease 1-like 1 (Pkhd1l1), mRNA [NM_001034931]	chr7	polycystic kidney and hepatic disease 1-like 1
A_64_P059160	-1.17	<±1.00		AI555711 UI-R-C2p-qr-b-08-0-UI.s1 UI-R-C2p Rattus norvegicus cDNA clone UI-R-C2p-qr-b-08-0-UI 3', mRNA sequence [AI555711]	chr17	cDNA clone UI-R-C2p-qr-b-08-0-UI 3
A_64_P093377	-1.18	<±1.00	Vom2r72	Rattus norvegicus vomeronasal 2 receptor, 72 (Vom2r72), mRNA [NM_001099517]	chr14	vomeronasal 2 receptor, 72
A_44_P466547	-1.18	<±1.00	Exoc3l1	Rattus norvegicus exocyst complex component 3-like 1 (Exoc3l1), mRNA [NM_001106178]	chr19	exocyst complex component 3-like 1
A_64_P082898	-1.18	<±1.00	Meig1	Rattus norvegicus meiosis expressed gene 1 (Meig1), mRNA [NM_001134882]	chr17	meiosis expressed gene 1
A_44_P260134	-1.18	<±1.00	Srcrb4d	Uncharacterized protein [Source:UniProtKB/TrEMBL;Acc:D3ZQH3] [ENSRNOT00000001953]	chr12	scavenger receptor cysteine rich domain containing, group B (4 domains)
A_64_P113204	-1.19	<±1.00	Zdhhc24	Rattus norvegicus zinc finger, DHHC-type containing 24 (Zdhhc24), mRNA [NM_001039100]	chr1	zinc finger, DHHC-type containing 24
A_64_P036965	-1.19	<±1.00	Mpz	Rattus norvegicus myelin protein zero (Mpz), mRNA [NM_017027]	chr13	myelin protein zero
A_64_P150603	-1.21	<±1.00	Ptger3	Rattus norvegicus prostaglandin E receptor 3 (subtype EP3) (Ptger3), mRNA [NM_012704]	chr2	prostaglandin E receptor 3 (subtype EP3)
A_44_P315937	-1.21	<±1.00	Cryaa	Rattus norvegicus crystallin, alpha A (Cryaa), mRNA [NM_012534]		crystallin, alpha A
A_64_P136407	-1.21	<±1.00	Dach2	Uncharacterized protein [Source:UniProtKB/TrEMBL;Acc:F1LX95] [ENSRNOT00000006907]	chrX	dachshund homolog 2 (Drosophila)
A_64_P024020	-1.22	<±1.00	Zbtb2	Rattus norvegicus zinc finger and BTB domain containing 2 (Zbtb2), mRNA [NM_001107460]	chr1	zinc finger and BTB domain containing 2
A_64_P092822	-1.23	<±1.00	Ucn2	Rattus norvegicus urocortin 2 (Ucn2), mRNA [NM_133385]	chr8	urocortin 2
A_64_P052867	-1.26	<±1.00	LOC688582	PREDICTED: Rattus norvegicus similar to hemicentin 1 (LOC688582), miscRNA [XR_085779]	chr3	similar to hemicentin 1
A_64_P105142	-1.28	<±1.00	Sall3	Rattus norvegicus sal-like 3 (Drosophila) (Sall3), mRNA [NM_001108892]	chr18	sal-like 3 (Drosophila)
A_64_P006633	-1.28	<±1.00	Olr563	Rattus norvegicus olfactory receptor 563 (Olr563), mRNA [NM_001000666]	chr3	olfactory receptor 563
A_44_P102369	-1.28	<±1.00	Socs1	Rattus norvegicus suppressor of cytokine signaling 1 (Socs1), mRNA [NM_145879]	chr10	suppressor of cytokine signaling 1
A_64_P108913	-1.30	<±1.00	RGD1565007	Rattus norvegicus similar to RIKEN cDNA 4632419K20 (RGD1565007), mRNA [NM_001134592]	chr2	similar to RIKEN cDNA 4632419K20
A_64_P136242	-1.32	<±1.00	Tbc1d2	Rattus norvegicus TBC1 domain family, member 2 (Tbc1d2), mRNA [NM_001107933]	chr5	TBC1 domain family, member 2
A_42_P473594	-1.32	<±1.00	Egr2	Rattus norvegicus early growth response 2 (Egr2), mRNA [NM_053633]	chr20	early growth response 2
A_64_P051367	-1.32	<±1.00	Glyatl3	Rattus norvegicus glycine-N-acyltransferase-like 3 (Glyatl3), mRNA [NM_001145062]	chr9	glycine-N-acyltransferase-like 3

A_64_P010353	-1.35	<±1.00	Micb	Rattus norvegicus MHC class I polypeptide-related sequence B (Micb), mRNA [NM_001017468]	chr1	MHC class I polypeptide-related sequence B
A_64_P037249	-1.36	<±1.00	Dhx33	Rattus norvegicus DEAH (Asp-Glu-Ala-His) box polypeptide 33 (Dhx33), mRNA [NM_001105802]	chr10	DEAH (Asp-Glu-Ala-His) box polypeptide 33
A_44_P234547	-1.39	<±1.00	Phf21b	Rattus norvegicus PHD finger protein 21B (Phf21b), mRNA [NM_001130680]	chr7	PHD finger protein 21B
A_64_P137833	-1.42	<±1.00	RT1-CE2	Rattus norvegicus RT1 class I, locus CE2 (RT1-CE2), mRNA [NM_001008840]	chr20	RT1 class I, locus CE2
A_64_P063009	-1.45	<±1.00	LOC680813	PREDICTED: Rattus norvegicus hypothetical protein LOC680813 (LOC680813), partial mRNA [XM_001058991]	chrX	hypothetical protein LOC680813
A_64_P097952	-1.46	<±1.00	Ttll13	Rattus norvegicus tubulin tyrosine ligase-like family, member 13 (Ttll13), mRNA [NM_001134962]	chr1	tubulin tyrosine ligase-like family, member 13
A_64_P042596	-1.51	<±1.00	RGD1307461	Rattus norvegicus similar to RIKEN cDNA 6430571L13 gene; similar to g20 protein (RGD1307461), mRNA [NM_001106854]	chr8	similar to RIKEN cDNA 6430571L13 gene; similar to g20 protein
A_44_P283176	-1.52	<±1.00	Spats1	Rattus norvegicus spermatogenesis associated, serine-rich 1 (Spats1), mRNA [NM_181376]	chr9	spermatogenesis associated, serine-rich 1
A_64_P098739	-1.55	<±1.00	LOC498350	Rattus norvegicus similar to testicular haploid expressed gene product isoform 2 (LOC498350), mRNA [NM_001017498]	chr14	similar to testicular haploid expressed gene product isoform 2
A_44_P419265	-1.57	<±1.00	Zscan12	Uncharacterized protein [Source:UniProtKB/TrEMBL;Acc:E9PU83] [ENSRNOT00000068397]	chr17	zinc finger and SCAN domain containing 12
A_64_P012557	-1.61	<±1.00	Fam64a	Rattus norvegicus family with sequence similarity 64, member A (Fam64a), mRNA [NM_001113781]	chr10	family with sequence similarity 64, member A
A_64_P134717	-1.64	<±1.00	LOC683313	Rattus norvegicus similar to keratin complex 2, basic, gene 6a (LOC683313), mRNA [NM_001101007]		similar to keratin complex 2, basic, gene 6a
A_44_P729029	-1.64	<±1.00	RGD1559502	Rattus norvegicus similar to RIKEN cDNA 1700025E21 (RGD1559502), mRNA [NM_001109228]	chr4	similar to RIKEN cDNA 1700025E21
A_44_P328340	-1.71	<±1.00	Tada2b	Rattus norvegicus transcriptional adaptor 2 (ADA2 homolog, yeast)-beta (Tada2b), mRNA [NM_001170455]	chr14	transcriptional adaptor 2B
A_64_P142492	-1.71	<±1.00	Nos2	Rattus norvegicus nitric oxide synthase 2, inducible (Nos2), mRNA [NM_012611]	chr10	nitric oxide synthase 2, inducible
A_44_P454532	-1.74	<±1.00	Ambp	Rattus norvegicus alpha-1-microglobulin/bikunin precursor (Ambp), mRNA [NM_012901]	chr5	alpha-1-microglobulin/bikunin precursor
A_64_P135172	-1.75	<±1.00		BM387339 UI-R-CN1-cjj-c-03-0-UI.s1 UI-R-CN1 Rattus norvegicus cDNA clone UI-R-CN1-cjj-c-03-0-UI 3', mRNA sequence [BM387339]	chr10	cDNA clone UI-R-CN1-cjj-c-03-0-UI 3'
A_64_P111644	-1.80	<±1.00	Olr63	Rattus norvegicus olfactory receptor 63 (Olr63), mRNA [NM_001000542]	chr1	olfactory receptor 63
A_64_P023227	-1.90	<±1.00	Abcg3l4	Rattus norvegicus ATP-binding cassette, subfamily G (WHITE), member 3-like 4 (Abcg3l4), mRNA [NM_001037205]	chr14 random	ATP-binding cassette, subfamily G (WHITE), member 3-like 4
A_64_P032332	-1.91	<±1.00	Tmprss11f	Uncharacterized protein [Source:UniProtKB/TrEMBL;Acc:F1M6D3] [ENSRNOT00000002745]	chr14	transmembrane protease, serine 11F
A_64_P118922	-1.92	<±1.00	Acss3	Rattus norvegicus acyl-CoA synthetase short-chain family member 3 (Acss3), mRNA [NM_001108091]	chr7	acyl-CoA synthetase short-chain family member 3
A_64_P086919	-1.97	<±1.00		Ig gamma-2B chain C region [Source:UniProtKB/Swiss-Prot;Acc:P20761]	chr6	Ig gamma-2B chain C region

				[ENSRNOT00000056843]		
A_64_P063953	-1.98	<±1.00	Xkr7	Rattus norvegicus XK, Kell blood group complex subunit-related family, member 7 (Xkr7), mRNA [NM_001012092]	chr3	XK, Kell blood group complex subunit-related family, member 7
A_64_P128998	-2.04	<±1.00	LOC307974	Rattus norvegicus similar to dJ1016N21.1 (novel protein (ortholog of Drosophila Pecanex (PCX), similar to KIAA0805)) (LOC307974), mRNA [XM_226603]	chr19 random	similar to dJ1016N21.1 (novel protein (ortholog of Drosophila Pecanex (PCX), similar to KIAA0805))
A_64_P077778	-2.06	<±1.00	Spry3	Rattus norvegicus sprouty homolog 3 (Drosophila) (Spry3), mRNA [NM_001109063]	chr12	sprouty homolog 3 (Drosophila)
A_44_P283812	-2.06	<±1.00	Fam46c	Rattus norvegicus family with sequence similarity 46, member C (Fam46c), mRNA [NM_001014041]	chr2	family with sequence similarity 46, member C
A_64_P162348	-2.07	<±1.00		Rattus norvegicus similar to beta-actin (LOC302340), mRNA [XM_228468]	chrX	similar to beta-actin
A_64_P135614	-2.12	<±1.00		Putative uncharacterized protein RGD1559942_predictedUncharacterized protein [Source:UniProtKB/TrEMBL;Acc:D3ZXR2] [ENSRNOT00000059680]	chr11	Putative uncharacterized protein RGD1559942_predictedUncharacterized protein
A_64_P164032	-2.35	<±1.00	Olr95	Rattus norvegicus olfactory receptor 95 (Olr95), mRNA [NM_001001024]	chr1	olfactory receptor 95
A_43_P12274	-2.65	<±1.00	Lst1	Rattus norvegicus leukocyte specific transcript 1 (Lst1), mRNA [NM_022634]	chr20	leukocyte specific transcript 1
A_64_P084757	-2.66	<±1.00		Rattus norvegicus similar to Adapter-related protein complex 1 sigma 1B subunit (Sigma-adaptin 1B) (Adaptor protein complex AP-1 sigma-1B subunit) (Golgi adaptor HA1/AP1 adaptin sigma-1B subunit) (Clathrin assembly protein complex 1 sigma-1B small chain) (Sigma 1B s... (LOC302671), mRNA [XM_217618]	chrX	similar to Adapter-related protein complex 1 sigma 1B subunit (Sigma-adaptin 1B)
A_44_P274217	-2.86	<±1.00	Tcte3	tctex1 domain-containing protein 3 [Source:RefSeq peptide;Acc:NP_001178488] [ENSRNOT00000020552]	chr1	t-complex-associated-testis-expressed 3
A_64_P076057	-2.95	<±1.00	LOC685716	PREDICTED: Rattus norvegicus similar to OX-2 membrane glycoprotein precursor (MRC OX-2 antigen) (CD200 antigen) (LOC685716), mRNA [XM_001064969]	chr11	similar to OX-2 membrane glycoprotein precursor (MRC OX-2 antigen) (CD200 antigen)
A_44_P126114	-3.39	<±1.00		Rattus norvegicus similar to RIKEN cDNA 5830443L24 (LOC289446), mRNA [XM_223169]	chr14	similar to RIKEN cDNA 5830443L24
A_64_P126734	-3.40	<±1.00	RGD1563185	PREDICTED: Rattus norvegicus similar to Glutathione S-transferase 8 (GST 8-8) (Chain 8) (GST class-alpha) (RGD1563185), mRNA [XM_576040]	chr6	similar to Glutathione S-transferase 8 (GST 8-8) (Chain 8)
A_64_P021850	-3.47	<±1.00	LOC499643	Rattus norvegicus similar to hypothetical protein FLJ25371 (LOC499643), mRNA [NM_001024301]	chr2	similar to hypothetical protein FLJ25371
A_44_P121586	-3.50	<±1.00	Tpte	Rattus norvegicus transmembrane phosphatase with tensin homology (Tpte), mRNA [NM_001108877]	chr16	transmembrane phosphatase with tensin homology
A_64_P121379	-4.10	<±1.00	LOC691259	Rattus norvegicus hypothetical protein LOC691259 (LOC691259), mRNA [NM_001109632]	chr10	hypothetical protein LOC691259
A_44_P399933	-4.42	<±1.00	Sox12	Rattus norvegicus SRY (sex determining region Y)-box 12 (Sox12), mRNA [NM_001168650]	chr3	SRY (sex determining region Y)-box 12
A_44_P520642	-4.73	<±1.00	RGD1563975	Rattus norvegicus similar to testis expressed sequence 13B (RGD1563975), mRNA [NM_001195270]	chrX	similar to testis expressed sequence 13B
A_64_P026088	<±1.00	4.01	Cd5l	Rattus norvegicus Cd5 molecule-like (Cd5l), mRNA [NM_001025685]	chr2	Cd5 molecule-like

A_64_P053174	<±1.00	3.61	Agbl1	PREDICTED: Rattus norvegicus similar to hypothetical protein D430020F16 (RGD1560280), mRNA [XM_001063833]	chr1	similar to hypothetical protein D430020F16
A_64_P124731	<±1.00	2.94	RGD1561693	PREDICTED: Rattus norvegicus similar to Gene model 784 (RGD1561693), miscRNA [XR_085950]	chrX	similar to Gene model 784
A_64_P028252	<±1.00	2.70	Spink13	Rattus norvegicus serine peptidase inhibitor, Kazal type 13 (Spink13), mRNA [NM_001109539]	chr18	serine peptidase inhibitor, Kazal type 13
A_64_P034546	<±1.00	2.50	RGD1561909	Rattus norvegicus similar to chromosome 6 open reading frame 148 (RGD1561909), mRNA [NM_001109334]	chr1	similar to chromosome 6 open reading frame 148
A_44_P534753	<±1.00	2.47	Zmynd15	Rattus norvegicus zinc finger, MYND-type containing 15 (Zmynd15), mRNA [NM_001105800]	chr10	zinc finger, MYND-type containing 15
A_64_P056698	<±1.00	2.41	Pom121l2	Rattus norvegicus POM121 membrane glycoprotein-like 2 (Pom121l2), transcript variant 2, mRNA [NM_001162931]	chr17	POM121 membrane glycoprotein-like 2
A_64_P063721	<±1.00	2.05	Ano2	PREDICTED: Rattus norvegicus similar to Transmembrane protein 16B, transcript variant 2 (LOC683001), mRNA [XM_001066415]	chr4	similar to Transmembrane protein 16B, transcript variant 2
A_64_P080509	<±1.00	1.98	Fut1	Rattus norvegicus fucosyltransferase 1 (Fut1), mRNA [NM_031236]	chr1	fucosyltransferase 1
A_43_P16232	<±1.00	1.87	Htr5b	Rattus norvegicus 5-hydroxytryptamine (serotonin) receptor 5B (Htr5b), mRNA [NM_024395]	chr13	5-hydroxytryptamine (serotonin) receptor 5B
A_64_P166316	<±1.00	1.76	LOC690097	Shultzomica02182 Rat lung airway and parenchyma cDNA libraries Rattus norvegicus cDNA clone Contig1844 5', mRNA sequence [CF108931]	chr4	cDNA clone Contig1844 5'
A_64_P148906	<±1.00	1.75	Aspg	Rattus norvegicus asparaginase homolog (S. cerevisiae) (Aspg), mRNA [NM_144750]	chr6	asparaginase homolog (S. cerevisiae)
A_64_P147423	<±1.00	1.73	Fzd4	Rattus norvegicus frizzled family receptor 4 (Fzd4), mRNA [NM_022623]	chr1	frizzled family receptor 4
A_44_P382423	<±1.00	1.73	Bnc2	Rattus norvegicus basonuclin 2 (Bnc2), mRNA [NM_001106666]	chr5	basonuclin 2
A_64_P136178	<±1.00	1.70	LOC689091	AGENCOURT_118861045 NIH_MGC_252 Rattus norvegicus cDNA clone IMAGE:9111687 5', mRNA sequence [EX491611]	chrUn	cDNA clone IMAGE:9111687 5
A_64_P012671	<±1.00	1.68	LOC100362274	PREDICTED: Rattus norvegicus hypothetical protein LOC100362274 (LOC100362274), mRNA [XM_002730098]	chrUn random	hypothetical protein LOC100362274
A_64_P035843	<±1.00	1.52		AMGNNUC:SRPB2-00196-F7-A srpb2 (10220) Rattus norvegicus cDNA clone srpb2-00196-f7 5', mRNA sequence [CB763787]	chr1	cDNA clone srpb2-00196-f7 5'
A_64_P010980	<±1.00	1.49	Fcrla	Rattus norvegicus Fc receptor-like A (Fcrla), mRNA [NM_001100682]	chr13	Fc receptor-like A
A_64_P102768	<±1.00	1.47	LOC690347	PREDICTED: Rattus norvegicus hypothetical protein LOC690347 (LOC690347), mRNA [XM_001074177]	chr9	hypothetical protein LOC690347
A_64_P104497	<±1.00	1.42		Rattus norvegicus chromosome 7, 38 clones, strain BN/SsNHsdMCW RNOR03304491, whole genome shotgun sequence [AABR03059028]	chr7	chromosome 7, 38 clones, strain BN/SsNHsdMCW RNOR03304491, whole genome shotgun sequence
A_44_P475356	<±1.00	1.41	LOC100363129	Rattus norvegicus LRRGT00018-like (LOC100363129), mRNA [NM_001177823]	chr19	LRRGT00018-like
A_64_P103479	<±1.00	1.41	Spinlw1	Rattus norvegicus serine peptidase inhibitor-like, with Kunitz and WAP domains 1 (eppin) (Spinlw1), mRNA [NM_001109457]	chr3	serine peptidase inhibitor-like, with Kunitz and WAP domains 1 (eppin)

A_64_P102280	<±1.00	1.40	Arhgap31	Rattus norvegicus Rho GTPase activating protein 31 (Arhgap31), mRNA [NM_001105879]	chr11	Rho GTPase activating protein 31
A_43_P19551	<±1.00	1.39	St6gal2	AMGNNUC:NRHY4-00050-E9-AV W Rat hypothalamus (10464) Rattus norvegicus cDNA clone nrhy4-00050-e9, mRNA sequence [CB605923]	chrUn	cDNA clone nrhy4-00050-e9
A_64_P134047	<±1.00	1.38	Kcnj2	Rattus norvegicus potassium inwardly-rectifying channel, subfamily J, member 2 (Kcnj2), mRNA [NM_017296]	chr10	potassium inwardly-rectifying channel, subfamily J, member 2
A_44_P178252	<±1.00	1.28	Ccl21	Rattus norvegicus chemokine (C-C motif) ligand 21 (Ccl21), mRNA [NM_001008513]	chr5	chemokine (C-C motif) ligand 21
A_44_P399249	<±1.00	1.26	Tgm1	Rattus norvegicus transglutaminase 1, K polypeptide (Tgm1), mRNA [NM_031659]	chr15	transglutaminase 1, K polypeptide
A_64_P114116	<±1.00	1.25		Q5KT07_RAT (Q5KT07) Spetex-2C, complete [TC591400]	chr15	Q5KT07_RAT (Q5KT07) Spetex-2C
A_64_P243132	<±1.00	1.25	Ccdc48	Rattus norvegicus coiled-coil domain containing 48 (Ccdc48), mRNA [NM_001163921]	chr4	coiled-coil domain containing 48
A_64_P163713	<±1.00	1.23	Pdxdc1	Rattus norvegicus pyridoxal-dependent decarboxylase domain containing 1 (Pdxdc1), mRNA [NM_001134961]	chr10	pyridoxal-dependent decarboxylase domain containing 1
A_64_P160008	<±1.00	1.23	Nxnl2	Rattus norvegicus nucleoredoxin-like 2 (Nxnl2), mRNA [NM_001170429]	chr17	nucleoredoxin-like 2
A_44_P468193	<±1.00	1.23	Mxd3	Rattus norvegicus Max dimerization protein 3 (Mxd3), mRNA [NM_145773]	chr17	Max dimerization protein 3
A_64_P040356	<±1.00	1.22		Q5KT07_RAT (Q5KT07) Spetex-2C, partial (4%) [TC640179]	chr17	Q5KT07_RAT (Q5KT07) Spetex-2C
A_64_P063214	<±1.00	1.22	Slc6a3	Rattus norvegicus solute carrier family 6 (neurotransmitter transporter, dopamine), member 3 (Slc6a3), mRNA [NM_012694]	chr1	solute carrier family 6 (neurotransmitter transporter, dopamine), member 3
A_44_P1003728	<±1.00	1.21	Lmod2	Rattus norvegicus leiomodin 2 (cardiac) (Lmod2), mRNA [NM_001100964]	chr4 random	leiomodin 2 (cardiac)
A_64_P110299	<±1.00	1.17	Hes5	Rattus norvegicus hairy and enhancer of split 5 (Drosophila) (Hes5), mRNA [NM_024383]	chr5	hairy and enhancer of split 5
A_43_P22972	<±1.00	1.16	Tmem71	PREDICTED: Rattus norvegicus transmembrane protein 71 (Tmem71), mRNA [XM_001075116]	chr7	transmembrane protein 71
A_64_P133791	<±1.00	1.14	Vav3	Rattus norvegicus vav 3 guanine nucleotide exchange factor (Vav3), mRNA [NM_001191714]	chr2	vav 3 guanine nucleotide exchange factor
A_64_P017208	<±1.00	1.13	Slc9a2	Rattus norvegicus solute carrier family 9 (sodium/hydrogen exchanger), member 2 (Slc9a2), transcript variant 1, mRNA [NM_001113335]	chr9	solute carrier family 9 (sodium/hydrogen exchanger), member 2
A_64_P000870	<±1.00	1.10	Kcna7	Rattus norvegicus potassium voltage-gated channel, shaker-related subfamily, member 7 (Kcna7), mRNA [NM_001108914]	chr1	potassium voltage-gated channel, shaker-related subfamily, member 7
A_64_P095554	<±1.00	1.10		Ig gamma-2A chain C region [Source:UniProtKB/Swiss-Prot;Acc:P20760] [ENSRNOT00000066209]	chr6	Ig gamma-2A chain C region
A_64_P027263	<±1.00	1.10	Zfp939	PREDICTED: Rattus norvegicus similar to zinc finger protein 11B (LOC690146), mRNA [XM_001073454]	chr1	similar to zinc finger protein 11B
A_43_P15538	<±1.00	1.09	Gja6	Rattus norvegicus gap junction protein, alpha 6 (Gja6), mRNA [NM_019308]	chrX	gap junction protein, alpha 6
A_44_P171071	<±1.00	1.09	RGD1306008	Rattus norvegicus similar to RIKEN cDNA 4930511I11 (RGD1306008), mRNA [NM_001113777]	chr20	similar to RIKEN cDNA 4930511I11

A_64_P130367	<±1.00	1.08		Q3WNI9_9RHIZ (Q3WNI9) Methylenetetrahydrofolate dehydrogenase (NADP+) , partial (8%) [TC627971]	chr10	Methylenetetrahydrofolate dehydrogenase (NADP+)
A_44_P960333	<±1.00	1.08	Mpzl2	Rattus norvegicus myelin protein zero-like 2 (Mpzl2), mRNA [NM_001106818]	chr8	myelin protein zero-like 2
A_64_P119592	<±1.00	1.07	Tfpi	Rattus norvegicus tissue factor pathway inhibitor (lipoprotein-associated coagulation inhibitor) (Tfpi), transcript variant 2, mRNA [NM_001177321]	chr3	tissue factor pathway inhibitor (lipoprotein-associated coagulation inhibitor)
A_64_P122158	<±1.00	1.07	RGD1566047	PREDICTED: Rattus norvegicus similar to MAP/microtubule affinity-regulating kinase 4 (MAP/microtubule affinity-regulating kinase like 1) (RGD1566047), mRNA [XM_574062]	chr17	similar to MAP/microtubule affinity-regulating kinase 4 (MAP/microtubule affinity-regulating kinase like 1)
A_64_P074102	<±1.00	1.06	Wnt2b	Rattus norvegicus wingless-type MMTV integration site family, member 2B (Wnt2b), mRNA [NM_001191848]	chr2	wingless-type MMTV integration site family, member 2B
A_64_P036616	<±1.00	1.06	Npr3	Rattus norvegicus natriuretic peptide receptor C/guanylate cyclase C (atrionatriuretic peptide receptor C) (Npr3), mRNA [NM_012868]	chr2	natriuretic peptide receptor C/guanylate cyclase C (atrionatriuretic peptide receptor C)
A_43_P12626	<±1.00	1.05	Msln	Rattus norvegicus mesothelin (Msln), mRNA [NM_031658]	chr10	mesothelin
A_64_P011324	<±1.00	1.04	Ahrr	Rattus norvegicus aryl-hydrocarbon receptor repressor (Ahrr), mRNA [NM_001024285]	chr1	aryl-hydrocarbon receptor repressor
A_43_P20422	<±1.00	1.04	Cdc14a	Rattus norvegicus CDC14 cell division cycle 14 homolog A (S. cerevisiae) (Cdc14a), transcript variant 2, mRNA [NM_001107718]	chr2	CDC14 cell division cycle 14 homolog A (S. cerevisiae)
A_64_P043851	<±1.00	1.03	Rapgef1	PREDICTED: Rattus norvegicus Rap guanine nucleotide exchange factor (GEF) 1 (Rapgef1), mRNA [XM_216018]	chr3	Rap guanine nucleotide exchange factor (GEF) 1
A_44_P657993	<±1.00	1.03	Gpr22	Rattus norvegicus G protein-coupled receptor 22 (Gpr22), mRNA [NM_001106722]	chr6	G protein-coupled receptor 22
A_64_P030654	<±1.00	1.02	Inhba	Rattus norvegicus inhibin beta-A (Inhba), mRNA [NM_017128]	chr17	inhibin beta-A
A_44_P142242	<±1.00	1.02	Cdh1	Rattus norvegicus cadherin 1 (Cdh1), mRNA [NM_031334]	chr19	cadherin 1
A_43_P11861	<±1.00	1.02	Dio3	Rattus norvegicus deiodinase, iodothyronine, type III (Dio3), mRNA [NM_017210]	chr6_random	deiodinase, iodothyronine, type III
A_64_P136716	<±1.00	1.02	Arid3c	Rattus norvegicus AT rich interactive domain 3C (BRIGHT-like) (Arid3c), mRNA [NM_001173981]	chr5	AT rich interactive domain 3C (BRIGHT-like)
A_64_P124210	<±1.00	1.02	Greb1l	PREDICTED: Rattus norvegicus similar to GREB1 protein isoform a (RGD1562371), mRNA [XM_574101]	chr18	similar to GREB1 protein isoform
A_64_P067259	<±1.00	1.02	Col4a4	Rattus norvegicus collagen, type IV, alpha 4 (Col4a4), mRNA [NM_001008332]	chr9	collagen, type IV, alpha 4
A_64_P059820	<±1.00	1.01	Chrna7	Neuronal acetylcholine receptor subunit alpha-7 [Source:UniProtKB/Swiss-Prot;Acc:Q05941] [ENSRNOT00000020760]	chr1	Neuronal acetylcholine receptor subunit alpha-7
A_64_P094287	<±1.00	1.00	Agl	Rattus norvegicus amylo-alpha-1, 6-glucosidase, 4-alpha-glucanotransferase (Agl), mRNA [NM_001108564]	chr2	amylo-alpha-1, 6-glucosidase, 4-alpha-glucanotransferase
A_64_P095298	<±1.00	1.00	LOC500877	Rattus norvegicus Ab1-152 (LOC500877), mRNA [NM_001047963]	chr7	Ab1-152

Numerical values in this table mean the logarithm of [gene expression of group C]/ [gene expression of group B] to base two.

Table S2. Examples of epilepsy-related genes with differential expression between group B (priming stimulation only) and group C (priming stimulation and test stimulation-induced audiogenic seizures).

*Gene Symbol	GeneName	*Lgi1* mutant (Group C vs Group B)	WT (Group C vs Group B)
Kcnj13	potassium inwardly-rectifying channel, subfamily J, member 13	-1.17	< +-1.00
Cryaa	crystallin, alpha A	-1.21	< +-1.00
Egr	early growth response 2	-1.32	< +-1.00
Nos2	nitric oxide synthase 2, inducible	-1.71	< +-1.00
Tex28	testis expressed 28	2.32	< +-1.00
Slc12a3	solute carrier family 12 (sodium/chloride transporters), member 3	1.54	< +-1.00
Drd2	dopamine receptor D2	1.41	< +-1.00
Stam	signal transducing adaptor molecule (SH3 domain and ITAM motif) 1	1.13	< +-1.00
Fzd4	frizzled family receptor 4	< +-1.00	1.73
Kcnj2	potassium inwardly-rectifying channel, subfamily J, member 2	< +-1.00	1.38
Slc6a3	solute carrier family 6 (neurotransmitter transporter, dopamine), member 3	< +-1.00	1.22
Hes5	hairy and enhancer of split 5	< +-1.00	1.17
Tfpi	tissue factor pathway inhibitor (lipoprotein-associated coagulation inhibitor)	< +-1.00	1.07
Rapgef1	Rap guanine nucleotide exchange factor (GEF) 1	< +-1.00	1.03
Chrna7	Neuronal acetylcholine receptor subunit alpha-7	< +-1.00	1.01
Agl	amylo-alpha-1, 6-glucosidase, 4-alpha-glucanotransferase	< +-1.00	1.00
Opalin	oligodendrocytic myelin paranodal and inner loop protein	< +-1.00	-1.00
Apod	apolipoprotein D	< +-1.00	-1.01
Slc4a1	solute carrier family 4 (anion exchanger), member 1	< +-1.00	-1.01
Pax4	paired box 4	< +-1.00	-1.02
Nfil3	nuclear factor, interleukin 3 regulated	< +-1.00	-1.04
Ctgf	connective tissue growth factor	< +-1.00	-1.06
Mog	myelin oligodendrocyte glycoprotein	< +-1.00	-1.07
Sgk2	serum/glucocorticoid regulated kinase 2	< +-1.00	-1.07
Ntrk2	neurotrophic tyrosine kinase, receptor, type 2	< +-1.00	-1.07

Gjc2	gap junction protein, gamma 2	< +-1.00	-1.08
Fa2h	fatty acid 2-hydroxylase	< +-1.00	-1.14
Cyp11a1	cytochrome P450, family 11, subfamily a, polypeptide 1	< +-1.00	-1.15
Pign	phosphatidylinositol glycan, class N	< +-1.00	-1.15
P2ry2	purinergic receptor P2Y, G-protein coupled, 2	< +-1.00	-1.16
Adamts4	ADAM metallopeptidase with thrombospondin type 1 motif, 4	< +-1.00	-1.19
Cldn11	claudin 11	< +-1.00	-1.20
Plp1	proteolipid protein 1	< +-1.00	-1.21
Ngfr	nerve growth factor receptor (TNFR superfamily, member 16)	< +-1.00	-1.23
Cd40	CD40 molecule, TNF receptor superfamily member 5	< +-1.00	-1.27
Klk6	kallikrein related-peptidase 6	< +-1.00	-1.27
Best1	bestrophin 1	< +-1.00	-1.33
Klf4	Kruppel-like factor 4 (gut)	< +-1.00	-1.42
Fos	FBJ osteosarcoma oncogene	< +-1.00	-1.48
Junb	jun B proto-oncogene	< +-1.00	-1.53
Arc	activity-regulated cytoskeleton-associated protein	< +-1.00	-1.56
Dusp1	dual specificity phosphatase 1	< +-1.00	-1.66
Pax9	paired box 9	< +-1.00	-1.68
Kcnk16	potassium channel, subfamily K, member 16	< +-1.00	-1.83
Folr1	folate receptor 1 (adult)	< +-1.00	-2.10
Slc10a4	solute carrier family 10 (sodium/bile acid cotransporter family), member 4	< +-1.00	-2.21
Atp7a	Copper-transporting ATPase 1	< +-1.00	-2.45
Slc19a3	solute carrier family 19, member 3	1.43	2.02
Zic4	Zic family member 4	1.07	1.14
Nts	neurotensin	2.36	-4.74
Rgs9	regulator of G-protein signaling 9	1.79	-1.14
Adora2a	adenosine A2a receptor	1.69	-1.71
Eln	elastin	-2.07	1.60
Hdc	histidine decarboxylase	-2.02	-3.03
Spef2	sperm flagellar 2	-1.11	-1.22
Gins2	GINS complex subunit 2 (Psf2 homolog)	-1.06	-1.42

*Genes were found using PubMed, Sciverse Scopus and Web of Science, with the search terms 'epilepsy and [gene name]'. Genes in boldface type have interaction with *Lgi1* gene found by using STRING, with the search terms 'Lgi1 and [gene name]'. Genes in underline type have weaker interaction with *Lgi1*. Numerical values in this table mean the logarithm of [gene expression of group C]/ [gene expression of group B] to base two.